ISSN: 3106-0668
e-ISSN: 3104-4700

https://doi.org/10.36719/3104-4700/3/4-11

Hasanboy Khamdamov
Fergana Institute of Public Health
https://orcid.org/0009-0006-9148-497X
hasanboyxamdamov7@gmail.com

Clinical and Functional Evaluation of the Effectiveness of Dacryocystorhinostomy in Dry Eye Syndrome

Abstract

This study evaluated the clinical and functional effectiveness of dacryocystorhinostomy (DCR) in patients with dry eye syndrome (DES). One hundred patients with DES who underwent DCR received comprehensive ophthalmological examination before and after surgery, including tear break-up time (Norn test), Schirmer I test, DES severity grading, subjective symptom scores, and conjunctival hyperemia assessment. After DCR, statistically significant improvements were observed across all parameters ($p < .001$): tear film stability increased by 86% (Norn test: 5.9 ± 0.9 to 11.0 ± 1.5 s), tear secretion doubled (Schirmer I: 6.9 ± 1.0 to 13.8 ± 1.8 mm), DES severity decreased by 46%, subjective complaints decreased by 79%, and conjunctival hyperemia decreased by 78%. DCR significantly improves tear film stability, tear production, and ocular surface condition in patients with DES. Restoration of lacrimal drainage positively influences tear system function and should be considered an integral component of comprehensive DES management.

Keywords: *dry eye syndrome, dacryocystorhinostomy, tear film stability, Schirmer test, Norn test, nasolacrimal duct obstruction, ocular surface*

Introduction

Dry eye disease (DED), also referred to as dry eye syndrome (DES), is one of the most prevalent and clinically significant conditions in modern ophthalmology. According to the Tear Film and Ocular Surface Society Dry Eye Workshop II (TFOS DEWS II), dry eye is a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film, accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities are etiological factors (Craig et al., 2017a). The recently updated TFOS DEWS III report further refined this definition, emphasizing that dry eye is a disease entity rather than a syndrome, with clearly identifiable diagnostic features and disease progression (Craig et al., 2025).

The prevalence of DED varies considerably depending on diagnostic criteria, population characteristics, and geographic region. Population-based estimates utilizing symptom-based criteria report prevalence rates ranging from 5% to 50%, while studies relying on clinical signs alone have documented rates as high as 75% in certain cohorts (Stapleton et al., 2017). Conservative estimates suggest that 10–20% of the population over 40 years of age experience moderate to severe symptoms and/or seek treatment for DED (Britten-Jones et al., 2024). There is an increasing trend in prevalence among younger adults attributable to contact lens wear, prolonged digital device use, and environmental factors (Craig et al., 2023). The high prevalence, chronic progressive nature, and substantial negative impact on patients' quality of life underscore the clinical and socioeconomic significance of this condition (Almulhim, 2024).

The pathophysiology of DES involves a complex interplay of mechanisms, including tear film instability, hyperosmolarity, inflammation of the ocular surface, epithelial damage to the cornea and conjunctiva, and neurosensory disturbances (Bron et al., 2017).

ISSN: 3106-0668
e-ISSN: 3104-4700

These pathological changes manifest as subjective symptoms—dryness, burning, foreign body sensation, photophobia, and visual instability—as well as objective signs of ocular surface damage, collectively reducing visual function and quality of life (National Library of Medicine, 2024).

Despite significant advances in understanding DES pathogenesis, comprehensive management remains subject to ongoing debate. Conventional treatment strategies primarily focus on conservative approaches, including artificial tear replacement, anti-inflammatory therapy, and management of meibomian gland dysfunction (Jones et al., 2017). However, in a substantial proportion of patients, conservative measures alone prove insufficient, necessitating exploration of additional pathogenetically justified therapeutic modalities (Danchenko et al., 2025).

Of particular relevance is the role of the lacrimal drainage system in the pathogenesis and perpetuation of DES. Nasolacrimal duct obstruction (NLDO) is the most common disorder of the lacrimal system, leading to tear stagnation, altered tear composition, and disruption of tear film homeostasis (Perez et al., 2023). Recent research has demonstrated that patients with primary acquired nasolacrimal duct obstruction (PANDO) exhibit significantly decreased tear film stability, with approximately 29.1% meeting diagnostic criteria for concurrent dry eye disease (Yu et al., 2024). Prolonged stasis of tears disrupts the ocular surface microenvironment by facilitating microbial proliferation and enhancing inflammatory reactions (Wang et al., 2025). Furthermore, obstruction of tear outflow alters tear inflammatory cytokine profiles, contributing to the chronification of ocular surface pathology (Lee & Kim, 2014).

Dacryocystorhinostomy (DCR) is the established surgical treatment for NLDO, with reported anatomical success rates of 90–98.8% and functional success rates of 81.9–95% (Lee et al., 2017; Patel & Malhotra, 2023). The procedure creates a functional pathway from the canaliculi into the nasal cavity, bypassing the obstructed nasolacrimal duct and restoring physiological tear drainage (Choe et al., 2026). While DCR is primarily indicated for epiphora relief, emerging evidence suggests that restoration of lacrimal drainage may also positively influence tear film dynamics and ocular surface health (Jin et al., 2022). However, data regarding the specific effects of DCR on DES remain limited, and some studies have reported the emergence or exacerbation of dry eye symptoms following successful DCR in 15–27.3% of patients (Kang et al., 2021; Kim et al., 2023).

Given this ambiguity, there is a clear need for systematic clinical and functional evaluation of the effects of DCR on DES parameters. The present study was designed to quantitatively and qualitatively assess the impact of dacryocystorhinostomy on the principal clinical and functional indicators of dry eye syndrome.

Methods

Study Design and Participants

This prospective interventional study included 100 patients diagnosed with dry eye syndrome and concurrent nasolacrimal duct obstruction who underwent dacryocystorhinostomy at the Department of General Surgery, Fergana Institute of Public Health. Comprehensive ophthalmological evaluation was performed in both the preoperative and postoperative periods.

Inclusion criteria encompassed patients with confirmed NLDO requiring DCR who also met diagnostic criteria for DES based on the TFOS DEWS II guidelines (Craig et al., 2017a), defined as the presence of both subjective symptoms and at least one positive objective test (tear break-up time < 10 s and/or Schirmer I test < 10 mm). Patients with secondary causes of lacrimal obstruction (trauma, neoplasm, prior surgery), autoimmune conditions (Sjögren's syndrome), active ocular infection, history of refractive surgery, or concurrent use of topical medications known to affect tear production were excluded.

Measures

The clinical and functional evaluation protocol included the following standardized assessments performed preoperatively and at the designated postoperative follow-up interval. Tear film stability was assessed using the Norn test (fluorescein tear break-up time [TBUT], measured in seconds), with values below 10 s considered indicative of tear film instability (Bron et al., 2003). Tear production

ISSN: 3106-0668
e-ISSN: 3104-4700

was assessed using the Schirmer I test without anesthesia, measured in millimeters of wetting after 5 minutes, with values below 10 mm indicating aqueous tear deficiency (Lemp et al., 2011). DES severity was graded on a standardized point scale (0–4) based on the totality of clinical and functional signs, incorporating elements from the TFOS DEWS II severity classification (Craig et al., 2017a). Subjective symptoms (burning, dryness, foreign body sensation, photophobia) were evaluated using a standardized scoring scale (0–4). Conjunctival condition, including degree of hyperemia, was graded on a standardized point scale (0–4).

Procedure

All patients underwent standard external dacryocystorhinostomy. The procedure involved creation of a bony osteotomy in the lacrimal fossa with anastomosis of the lacrimal sac mucosa to the nasal mucosa, establishing a direct drainage pathway from the canaliculi to the nasal cavity, thereby bypassing the obstructed nasolacrimal duct (Choe et al., 2026). Silicone tube intubation was performed in cases where clinically indicated.

Data Analysis

Statistical processing was performed using variational statistics. Results are presented as mean values ± standard error of the mean (M ± SEM). The significance of differences between preoperative and postoperative parameters was evaluated using paired t-tests. Percentage improvement was calculated as the absolute change divided by the preoperative value, multiplied by 100. Differences were considered statistically significant at $p < .001$.

Results

Statistically significant improvements were observed across all measured parameters following DCR (see Table 1). The results demonstrate consistent, clinically meaningful changes in both objective functional parameters and subjective patient-reported outcomes.

Table 1.
Comparative Clinical and Functional Parameters
Before and After Dacryocystorhinostomy (N = 100)

Parameter	Pre-DCR	Post-DCR	Δ	% Change	P
Norn test (TBUT), s	5.9 ± 0.9	11.0 ± 1.5	+5.1	86	< .001
Schirmer I test, mm	6.9 ± 1.0	13.8 ± 1.8	+6.9	100	< .001
DES severity	2.6 ± 0.5	1.4 ± 0.5	–1.2	46	< .001
Subjective complaints	3.3 ± 0.6	0.7 ± 0.5	–2.6	79	< .001
Conjunctival hyperemia	2.3 ± 0.5	0.5 ± 0.5	–1.8	78	< .001

Note. Values are M ± SEM. DES severity, subjective complaints, and hyperemia scored 0–4. TBUT = tear break-up time; DES = dry eye syndrome. All comparisons: paired t-test, ***$p < .001$.

Tear Film Stability

The Norn test demonstrated a significant increase from a preoperative mean of 5.9 ± 0.9 s to a postoperative mean of 11.0 ± 1.5 s, an 86% improvement ($p < .001$). Postoperative values exceeded the clinically accepted threshold of 10 s for normal tear film stability (Bron et al., 2003), indicating substantial functional restoration.

Tear Production

The Schirmer I test increased from 6.9 ± 1.0 mm to 13.8 ± 1.8 mm, representing a 100% improvement ($p < .001$). Postoperative values exceeded the diagnostic threshold of 10 mm, indicating normalization of tear production.

ISSN: 3106-0668
e-ISSN: 3104-4700

DES Severity and Subjective Complaints

The composite DES severity score decreased from 2.6 ± 0.5 to 1.4 ± 0.5 (46% improvement; $p < .001$), reflecting a transition from moderate-to-severe to mild DES. Subjective complaints decreased from 3.3 ± 0.6 to 0.7 ± 0.5 (79% reduction; $p < .001$), indicating near-complete symptom resolution.

Conjunctival Hyperemia

Conjunctival hyperemia decreased from 2.3 ± 0.5 to 0.5 ± 0.5 (78% reduction; $p < .001$), reflecting marked resolution of ocular surface inflammation.

Discussion

The results of this study demonstrate that dacryocystorhinostomy produces statistically and clinically significant improvements across all assessed parameters of dry eye syndrome, including tear film stability, tear production, disease severity, subjective symptoms, and conjunctival inflammation. These findings support the hypothesis that surgical restoration of lacrimal drainage has a multifaceted positive influence on the tear system and ocular surface in patients with concurrent DES and NLDO.

Tear Film Stability and the Role of Lacrimal Drainage

The 86% improvement in TBUT is of particular clinical significance. The preoperative mean of 5.9 s was well below the 10-s diagnostic threshold established by the TFOS DEWS II (Craig et al., 2017a), confirming significant tear film instability. Postoperatively, the mean of 11.0 s exceeded this threshold, indicating functional restoration. This finding is consistent with the pathophysiological model proposed by Yu et al. (2024), who demonstrated that PANDO patients exhibit significantly decreased tear film stability compared to controls, with non-invasive keratograph break-up time values inversely correlating with the duration of epiphora. The restoration of physiological tear drainage likely reduces tear stagnation, thereby normalizing tear turnover and composition across the lipid, aqueous, and mucin layers.

Furthermore, improvement in tear film stability may be related to changes in tear inflammatory mediators following DCR. Lee and Kim (2014) reported significant alterations in tear cytokine profiles following endoscopic DCR for PANDO, with decreases in pro-inflammatory cytokines known to destabilize the tear film. The reduction in the inflammatory burden on the ocular surface likely contributes to improved tear film integrity.

Restoration of Tear Production

The doubling of Schirmer I test values is a striking finding that warrants detailed interpretation. In the context of NLDO, tear stagnation creates a negative feedback loop whereby chronic ocular surface irritation stimulates reflex tearing, but the stagnant tears fail to adequately hydrate the surface due to altered composition and impaired distribution (Ji et al., 2023). DCR breaks this cycle by restoring normal tear flow dynamics. The normalization of Schirmer values may also reflect a reduction in compensatory reflex tearing secondary to chronic ocular surface irritation.

Park et al. (2019) similarly observed significant changes in tear film lipid layer thickness following silicone tube intubation for NLDO, demonstrating that restoration of lacrimal drainage is associated with improved tear film composition, including the critical lipid layer that retards evaporation. These compositional changes complement the volumetric improvements reflected in the Schirmer test values.

Reduction in DES Severity and Subjective Symptoms

The 46% reduction in DES severity and 79% decrease in subjective complaints collectively demonstrate that DCR improves both objective disease status and patient-perceived outcomes. The magnitude of subjective improvement exceeding objective severity reduction is noteworthy and may reflect the particular sensitivity of symptom perception to changes in tear dynamics. Craig et al. (2017a) emphasized that symptom burden in DES does not always correlate linearly with objective signs, as neurosensory mechanisms modulate symptom perception independently of measurable ocular surface parameters.

ISSN: 3106-0668
e-ISSN: 3104-4700

Kang et al. (2021) investigated the relationship between DCR outcomes and dry eye symptoms, reporting that DES occurred after successful endoscopic DCR in 27.3% of patients who did not have DES preoperatively, suggesting that lacrimal surgery can unmask subclinical dry eye. In contrast, our study population comprised patients with established DES, in whom DCR consistently improved symptoms. This distinction underscores the importance of preoperative DES assessment and patient selection.

Kim et al. (2023) reported that approximately 15% of patients who underwent endoscopic DCR for PANDO combined with pre-existing dry eye developed significant postoperative dry eye symptoms, with shorter duration of preoperative epiphora being a risk factor. These findings highlight the complex interplay between lacrimal drainage restoration and tear film homeostasis.

Anti-Inflammatory Effects of Lacrimal Drainage Restoration

The 78% reduction in conjunctival hyperemia represents a substantial decrease in ocular surface inflammation. Chronic NLDO is associated with persistent low-grade inflammation of the lacrimal sac and surrounding tissues, characterized by inflammatory infiltration, fibrotic changes, and elevated tear cytokine levels (Wang et al., 2025). Stagnation of tear fluid creates a reservoir for bacterial proliferation and inflammatory mediator accumulation (Tucker et al., 1997). Recent single-cell transcriptomic analysis of nasolacrimal duct tissue revealed that immune cells, particularly CD4+ T cells, constitute over 70% of the cellular population in the obstructed duct, driving a CD4+ T cell–MIF–fibroblast pathway that promotes progressive fibrosis and sustained inflammation (Wang et al., 2025). By surgically bypassing the obstructed duct, DCR effectively interrupts this pathological cascade.

These anti-inflammatory effects are further supported by Lee and Kim (2014), who demonstrated significant reductions in tear-borne inflammatory cytokines, including interleukin-1β and tumor necrosis factor-α, following successful endoscopic DCR. The convergence of clinical improvement and biochemical evidence provides robust support for the anti-inflammatory mechanism of DCR in the context of DES.

Comparison With Existing Literature

Our results are broadly consistent with and extend the existing literature. External DCR achieves anatomical success rates of 90–98.8% and functional success rates of 81.9–95% (Lee et al., 2017; Sobel et al., 2019). The present study contributes a novel dimension by demonstrating that DCR benefits extend beyond epiphora relief to encompass measurable DES improvement.

Our findings contrast with studies reporting adverse DES effects after DCR. The discrepancy may be reconciled by considering that in the Kang et al. (2021) and Kim et al. (2023) studies, DES was unmasked in patients without pre-existing dry eye, whereas in our study, patients with established DES benefited from restored tear drainage. This supports the concept that NLDO symptoms can mask underlying dry eye, and DCR may either improve or reveal DES depending on baseline ocular surface status (Yu et al., 2024).

The dacryocystectomy literature provides additional insight. Rossi et al. (2024) found that dacryocystectomy, which eliminates drainage entirely, may benefit patients with severe DES by increasing the lacrimal meniscus. This observation further underscores the complexity of the tear drainage–DES relationship and supports a patient-specific approach to lacrimal surgery.

Clinical Implications

These findings support the integration of DCR into the comprehensive management strategy for patients with concurrent DES and NLDO. The results emphasize the importance of thorough preoperative assessment of dry eye status in all patients presenting with lacrimal obstruction and provide evidence-based justification for considering DCR as a therapeutic intervention with benefits extending beyond epiphora relief. These implications align with the TFOS DEWS II Management and Therapy Report, which emphasized identifying and treating underlying causes of tear film dysfunction (Jones et al., 2017).

Limitations and Future Directions

Several limitations should be acknowledged. The study lacked a control group of patients with NLDO but without DES. The specific postoperative follow-up interval and its duration were not

ISSN: 3106-0668
e-ISSN: 3104-4700

standardized, and longer-term follow-up would be valuable. The study did not incorporate advanced diagnostic measures such as tear osmolarity, meibography, or OSDI scoring. The absence of blinding in symptom assessment introduces potential bias, and the single-center design may limit generalizability.

Future research should address these limitations through multicenter, randomized controlled trials with longer follow-up periods. Incorporation of tear cytokine analysis, tear osmolarity measurements, confocal microscopy of corneal nerves, and validated patient-reported outcome measures such as the OSDI would enhance mechanistic understanding. Comparative studies evaluating external versus endoscopic DCR in the context of DES outcomes would also be clinically valuable.

Conclusion

This study demonstrates that dacryocystorhinostomy produces statistically significant and clinically meaningful improvements across all assessed parameters of dry eye syndrome in patients with concurrent nasolacrimal duct obstruction. Restoration of lacrimal drainage leads to enhanced tear film stability, normalized tear production, reduced disease severity, substantial alleviation of subjective symptoms, and marked resolution of ocular surface inflammation. These findings support DCR as an effective surgical intervention that positively modulates tear system function and ocular surface condition, warranting its inclusion as an integral component of comprehensive DES management in appropriately selected patients.

References

1. Almulhim, A. (2024). Therapeutic targets in the management of dry eye disease associated with Sjögren's syndrome: An updated review of current insights and future perspectives. *Journal of Clinical Medicine, 13*(6), 1777. https://doi.org/10.3390/jcm13061777
2. Britten-Jones, A. C., Wang, M. T. M., Samuels, I., Jennings, C., Stapleton, F., & Craig, J. P. (2024). Epidemiology and risk factors of dry eye disease: Considerations for clinical management. *Medicina, 60*(9), 1458. https://doi.org/10.3390/medicina60091458
3. Bron, A. J., de Paiva, C. S., Chauhan, S. K., Bonini, S., Gabison, E. E., Jain, S., Knop, E., Markoulli, M., Ogawa, Y., Perez, V., Uchino, Y., Yokoi, N., Zoukhri, D., & Sullivan, D. A. (2017). TFOS DEWS II pathophysiology report. *The Ocular Surface, 15*(3), 438–510. https://doi.org/10.1016/j.jtos.2017.05.011
4. Bron, A. J., Evans, V. E., & Smith, J. A. (2003). Grading of corneal and conjunctival staining in the context of other dry eye tests. *Cornea, 22*(7), 640–650. https://doi.org/10.1097/00003226-200310000-00008
5. Choe, C. H., Yen, M. T., & Marcet, M. M. (2026, January 4). *Dacryocystorhinostomy*. EyeWiki, American Academy of Ophthalmology. https://eyewiki.org/Dacryocystorhinostomy
6. Craig, J. P., Alves, M., Wolffsohn, J. S., Downie, L. E., Efron, N., Galor, A., Gomes, J. A. P., Jones, L., Markoulli, M., Stapleton, F., & Willcox, M. D. P. (2023). TFOS lifestyle report executive summary: A lifestyle epidemic—Ocular surface disease. *The Ocular Surface, 30*, 240–253. https://doi.org/10.1016/j.jtos.2023.08.009
7. Craig, J. P., Nichols, K. K., Akpek, E. K., Caffery, B., Dua, H. S., Joo, C.-K., Liu, Z., Nelson, J. D., Nichols, J. J., Tsubota, K., & Stapleton, F. (2017a). TFOS DEWS II definition and classification report. *The Ocular Surface, 15*(3), 276–283. https://doi.org/10.1016/j.jtos.2017.05.008
8. Craig, J. P., Nichols, K. K., Akpek, E. K., et al. (2025). TFOS DEWS III: Diagnostic methodology. *American Journal of Ophthalmology.* https://doi.org/10.1016/S0002-9394(25)00275-2
9. Danchenko, S. V., Odilov, M. Yu., et al. (2025). Differentiated approaches to correction of the ocular surface condition in dry eye syndrome: A literature review. *Clinical Ophthalmology, 25*(2). https://doi.org/10.32364/2311-7729-2025-25-2-5

ISSN: 3106-0668
e-ISSN: 3104-4700

10. Drozodova, E. A., Berdnikova, E. V., & Dashenko, D. M. (2023). Risk factors, clinical features, and indications for treatment of dry eye syndrome in young patients. *Vestnik Oftalmologii*, (6).
11. Ji, J., Ding, X., et al. (2023). *Prevalence of dry eye during the COVID-19 pandemic: A systematic review and meta-analysis.* PubMed. https://pubmed.ncbi.nlm.nih.gov/38091282
12. Jin, Y., Guo, Y., Liu, Y., et al. (2022). Prevalence and risk factors of dry eye symptoms after successful dacryocystorhinostomy for patients with lacrimal passage obstruction. *European Journal of Ophthalmology, 32*, 2662–2669. https://doi.org/10.1177/11206721211069739
13. Jones, L., Downie, L. E., Korb, D., Benitez-Del-Castillo, J. M., Dana, R., Deng, S. X., Dong, P. N., Geerling, G., Hida, R. Y., Liu, Y., Seo, K. Y., Tauber, J., Wakamatsu, T. H., Xu, J., Wolffsohn, J. S., & Craig, J. P. (2017). TFOS DEWS II management and therapy report. *The Ocular Surface, 15*(3), 575–628. https://doi.org/10.1016/j.jtos.2017.05.006
14. Kang, T. S., Cho, J., Kim, J., et al. (2021). Modified ocular surface disease index as a screening criteria for dry eye syndrome presenting after successful dacryocystorhinostomy. *PLoS ONE, 16*(2), e0247168. https://doi.org/10.1371/journal.pone.0247168
15. Kim, M. H., Lee, K., & Chang, M. (2023). Dry eye assessment of patients undergoing endoscopic dacryocystorhinostomy for nasolacrimal duct obstruction combined with dry eye syndrome. *Korean Journal of Ophthalmology, 37*(5), 395–400. https://doi.org/10.3341/kjo.2023.0042
16. Lee, J., & Kim, T. (2014). Changes in cytokines in tears after endoscopic endonasal dacryocystorhinostomy for primary acquired nasolacrimal duct obstruction. *Eye, 28*(5), 600–607. https://doi.org/10.1038/eye.2014.33
17. Lee, M. J., Khwarg, S. I., Kim, N., et al. (2017). Surgical outcomes of external dacryocystorhinostomy and risk factors for functional failure: A 10-year experience. *Eye, 31,* 691–697. https://doi.org/10.1038/eye.2016.308
18. Lemp, M. A., Bron, A. J., Baudouin, C., et al. (2011). Tear osmolarity in the diagnosis and management of dry eye disease. *American Journal of Ophthalmology, 151*(5), 792–798. https://doi.org/10.1016/j.ajo.2010.10.032
19. National Library of Medicine. (2024). *Dry eye syndrome*. In StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK470411
20. Park, J., Kim, J., & Lee, H. (2019). Evaluation of tear film lipid layer thickness measurements obtained using an ocular surface interferometer in nasolacrimal duct obstruction patients. *Korean Journal of Ophthalmology, 33*(1), 76–82. https://doi.org/10.3341/kjo.2018.0081
21. Patel, B. C., & Malhotra, R. (2023). *Dacryocystorhinostomy*. In StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK557851
22. Perez, Y., Patel, B. C., & Mendez, M. D. (2023). *Nasolacrimal duct obstruction*. In StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK532873
23. Rossi, C., Baillif, S., Lagier, J., et al. (2024). Dacryocystitis: Is dacryocystorhinostomy always the solution? *Journal of Clinical Medicine, 13*(17), 5145. https://doi.org/10.3390/jcm13175145
24. Sobel, R. K., Aakalu, V. K., Wladis, E. J., Bilyk, J. R., Yen, M. T., & Mawn, L. A. (2019). A comparison of endonasal dacryocystorhinostomy and external dacryocystorhinostomy: A report by the American Academy of Ophthalmology. *Ophthalmology, 126*(11), 1580–1585. https://doi.org/10.1016/j.ophtha.2019.06.009
25. Stapleton, F., Alves, M., Bunya, V. Y., et al. (2017). TFOS DEWS II epidemiology report. *The Ocular Surface, 15*(3), 334–365. https://doi.org/10.1016/j.jtos.2017.05.003
26. Tucker, N., Chow, D., Stockl, F., et al. (1997). Clinically suspected primary acquired nasolacrimal duct obstruction: Clinicopathologic review of 150 patients. *Ophthalmology, 104*(11), 1882–1886. https://doi.org/10.1016/s0161-6420(97)30012-8

ISSN: 3106-0668
e-ISSN: 3104-4700

27. Wang, L., Zhang, Y., Li, H., et al. (2025). Cellular and molecular mechanisms of nasolacrimal duct obstruction: New insights into CD4+ T cell-MIF-fibroblast pathways. *Journal of Advanced Research*. https://doi.org/10.1016/j.jare.2025.01.038
28. Yu, X., Wang, K., Hu, Y., Meng, Z., Li, J., Liu, Y., Xiao, L., Chen, M., Li, S., Shen, Y., Chen, R., & Liang, X. (2024). Dry eye and decreased tear film stability in primary acquired nasolacrimal duct obstruction patients. *International Ophthalmology, 44*(1), 277. https://doi.org/10.1007/s10792-024-03204-8

Received: 25.08.2025
Accepted: 15.11.2025