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Functional State of Meibomian Glands in Military Personnel with Symptoms of Dry Eye Syndrome

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Abstract: Meibomian gland dysfunction (MGD) is considered a key pathogenic factor in the development of dry eye syndrome (DES). The aim of this study was to assess the anatomical and functional state of the meibomian glands in military personnel with symptoms of DES using the LacryDiag diagnostic system. Materials and Methods. A total of 120 military personnel (240 eyes) with complaints of DES symptoms were examined. Two control groups were formed: individuals with DES symptoms not serving in the military (n=40), and healthy participants (n=40). The study utilized meibography methods, visualization with LacryDiag, and calculation of the meibomian gland dysfunction index (MGDI). Gland density analysis was performed using the ImageJ software. Results. In the group of military personnel, the average meibomian gland density was 28.6%, corresponding to moderate atrophy. In control group 1, the value reached 51.4%, and in control group 2 — over 70%. The average MGDI value in the main group was 1.58±0.34 points, compared to 1.22±0.22 and 0.48±0.11 in the respective control groups ($p<0.05$). A strong positive correlation was established between the OSDI index and MGDI in military personnel ($r=0.701$). Conclusion. Military personnel demonstrate more pronounced meibomian gland dysfunction than civilian individuals, which confirms the need for in-depth diagnosis and prevention of DES using high-precision methods such as LacryDiag.

Keywords: Dry eye syndrome, meibomian glands, LacryDiag, dysfunction, military personnel.

Introduction: Dry eye syndrome (DES) is a widespread condition characterized by tear film instability and inflammation of the ocular surface, accompanied by subjective symptoms such as burning, itching, foreign body sensation, and dryness [1,2,3]. Meibomian gland dysfunction (MGD), as one of the leading causes of DES, has attracted considerable attention from ophthalmologists and researchers due to its significant contribution to the disease pathogenesis. Military personnel, as a specific patient population, are exposed to a variety of adverse factors including stress, prolonged outdoor activity, the use of protective eyewear, and limited access to medical care [4,5,6,7]. These conditions may contribute to the development or exacerbation of MGD, thereby increasing the frequency and severity of DES symptoms in this group.

Diagnosing MGD requires both clinical assessment and the use of modern instrumental methods. The LacryDiag system provides objective evaluation of the anatomical and functional status of the meibomian glands, allowing for high-precision visualization of gland damage. The use of this method enables a more detailed study of MGD-related changes in military personnel [1,8,9,10]. The present study aims to identify specific features of MGD in military personnel with DES symptoms and to perform a comparative analysis with

civilian individuals exhibiting similar symptoms or no ophthalmological pathology.

Objective of the Study. To assess the degree of meibomian gland dysfunction in military personnel with symptoms of dry eye syndrome (DES) using the LacryDiag diagnostic system, and to compare the findings with control groups of civilians both with and without DES symptoms.

METHODS

The study included 120 military personnel (240 eyes) with complaints of ocular discomfort associated with dry eye syndrome (DES) symptoms such as burning, itching, foreign body sensation, and dryness. The participants served in various units of the Armed Forces of the Republic of Uzbekistan. The mean age of the participants was 23.4±4.5 years, of whom 95 (79.2%) were men and 25 (20.8%) were women.

Inclusion criteria:

Conscription age (18–27 years);

Presence of ocular discomfort related to DES symptoms (burning, itching, foreign body sensation, dryness);

Signed informed consent to participate in the study.

Exclusion criteria:

History of ophthalmic diseases causing secondary DES (chemical burns, severe conjunctivitis, etc.);

Presence of ophthalmic diseases that could distort study results (excluding DES);

Laser refractive surgery performed within the last 3 months;

Presence of chronic somatic diseases in the stage of decompensation.

Control group 1 included 40 participants (80 eyes), 33 men (82.5%) and 7 women (17.5%), consisting of civilians with DES symptoms, matched by age and sex to ensure comparability with the main group.

Control group 2 included 40 participants (80 eyes), 32 men (80%) and 8 women (20%), consisting of healthy civilians without DES symptoms, also matched by age and sex to the main group.

The study employed general and specialized ophthalmic examination methods.

The state of the meibomian glands (MG) was assessed using the LacryDiag diagnostic system, which enables high-resolution meibography and infrared imaging. Participants underwent eyelid eversion with image capture of the glands. The images were analyzed using ImageJ software to determine MG density and classify the degree of gland atrophy. The Meibomian Gland Dysfunction Index (MGDI) was assessed based on a visual scale evaluating secretion consistency and quantity. An average dysfunction index was calculated based on eight glands of the lower eyelid per eye. The obtained numerical values were used for statistical analysis of differences between the groups.

Normally, MGs present with uniform thickness, distinct borders, and span the entire eyelid length. Mild dysfunction was defined as slight shortening or thinning of the glands with up to 25% area loss. Moderate dysfunction was defined as a loss of 25–50%, while severe dysfunction involved greater than 50% gland structure loss, with glands appearing markedly shortened or entirely absent.

Assessment of MGDI: The MGDI was based on clinical signs of gland dysfunction and secretion function.

Eyelid margin features were evaluated: redness, thickening, and signs of duct obstruction.

Secretory testing involved gentle compression of the eyelids using a standard instrument (e.g., cotton stick or other ophthalmic device).

The consistency of secretions was graded as follows:

Transparent fluid secretion: normal

Viscous, turbid, or absent secretion: dysfunction

Each gland was rated according to the following scale:

0 – Normal (transparent fluid secretion)

1 – Viscous or turbid secretion

2 – No secretion

Eight glands of the lower eyelid were assessed per eye, and the average score was calculated. The index was computed as:

MGDI = (Sum of all gland scores) / (Number of glands examined)

Classification of dysfunction severity:

0–0.5 – Normal

0.6–1.0 – Mild dysfunction

1.1–1.5 – Moderate dysfunction

1.6–2.0 – Severe dysfunction

Assessment of MG density was based on analysis of meibography images using ImageJ software. Non-functional zones were identified by absence, shortening, or tortuosity of the glands.

The result was expressed as a percentage, reflecting the proportion of preserved functional glands.

Density classification:

75% – Normal

50–75% – Mild atrophy

25–50% – Moderate atrophy

<25% – Severe atrophy

Statistical analysis was performed using SPSS version 26.0. The Shapiro–Wilk test was used to assess the normality of data distribution. Pearson's correlation coefficient was calculated to evaluate the relationship between MGDI and the OSDI index. Statistical significance was established at $p<0.05$.

RESULTS

Analysis of the distribution of eyes by the degree of meibomian gland dysfunction (MGD) in the study groups revealed significant differences among military personnel with DES symptoms, civilians with symptoms but not in military service, and healthy participants (Figure 1).

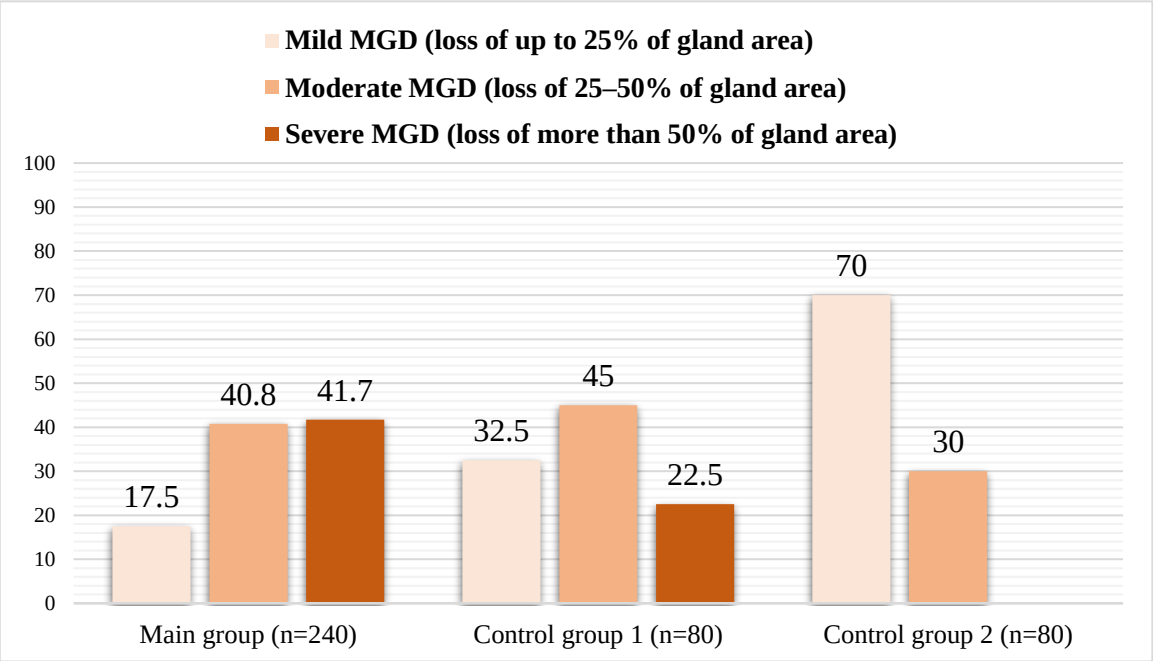

Figure 1. Distribution of eyes (%) by the degree of meibomian gland dysfunction (MGD) in the study groups.

In the main group (military personnel, n=240), the most common form was moderate MGD, observed in 41.7% of cases, characterized by a 25–50% loss in gland area. Mild dysfunction (loss of up to 25% gland area) was present in 40.8% of eyes, and severe dysfunction (loss of more than 50% gland area) was noted in 17.5% of eyes, indicating pronounced changes in MG status. In control group 1 (civilians with DES symptoms, n=80), the distribution was more favorable: 45% of eyes had mild dysfunction, 32.5% moderate, and 22.5% severe dysfunction. Control group 2 (healthy participants, n=80) showed the best outcomes: 70% of eyes exhibited only mild dysfunction, and only 30% demonstrated any signs of moderate or severe MGD, possibly due to individual anatomical features. Analysis of the average MG density in the study groups revealed significant differences (Figure 2).

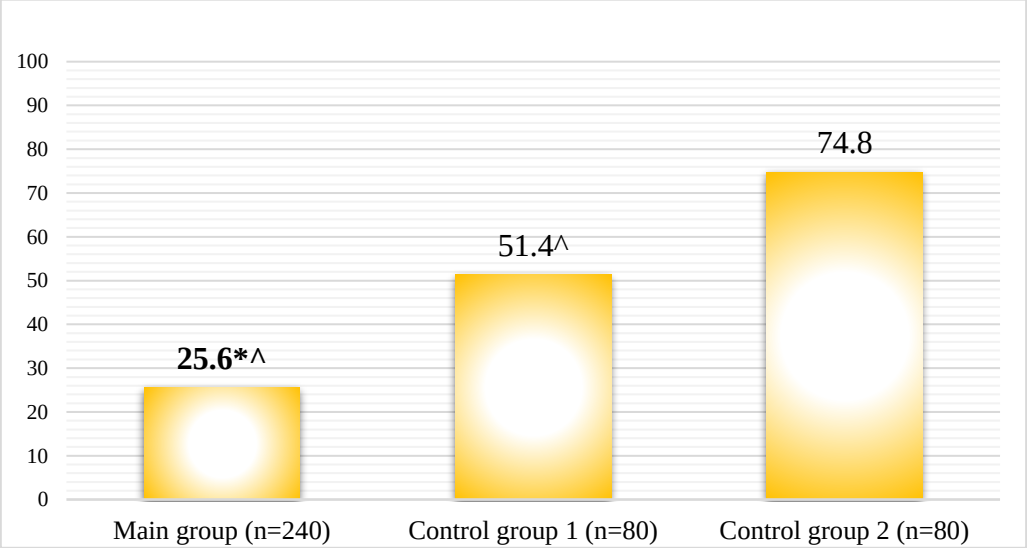

Figure 2. Average density (%) of meibomian glands in the study groups.

*** – statistically significant differences compared to control group 1 at p<0.05**

^ – statistically significant differences compared to control group 2 at p<0.05

In the main group of military personnel, the average MG density was 28.6%, indicating moderate atrophy with 25–50% loss of gland area. This value was significantly lower than that in both control group 1 (p<0.05) and control group 2 (p<0.05). In control group 1 (civilians with DES), average MG density was 51.4%, consistent with mild atrophy (50–75%). Despite the presence of DES symptoms, this value was significantly higher than in the main group (p<0.05), indicating less severe MG damage in civilians. However, the difference from control group 2 was also statistically significant (p<0.05).

Analysis of the Meibomian Gland Dysfunction Index (MGDI), based on gland secretory function, revealed that the average MGDI in the main group was 1.58±0.34 points, corresponding to moderate dysfunction approaching the severe range (1.6–2.0). This value was significantly higher than in control group 1 (1.22±0.22; p<0.05), indicating moderate dysfunction. Differences with control group 2 (0.48±0.11; p<0.05) were also statistically significant and within the normal range (Table 1).

Table 1

Results of Meibomian Gland Dysfunction Index (MGDI) evaluation.

Group	MGDI (Mean ± SD)
Main group (n=240)	1.58±0.34*^
Control group 1 (n=80)	1.22±0.22^
Control group 2 (n=80)	0.48±0.11

***- – significant differences vs. control group 1 (p<0.05); ^ – significant differences vs. control group 2 (p<0.05)**

Control group 1 exhibited a lower degree of MGD than the main group; however, the average value of 1.22 points still indicates moderate dysfunction, confirming the presence of pathology, albeit less pronounced than in military personnel.

Thus, the observed differences demonstrate that military personnel exhibit the most severe changes in both MG density and function, which may contribute to the development of DES and deterioration in quality of life. It is noteworthy that MGD severity was more pronounced than indicators of tear secretion, highlighting the central role of MGD in the pathogenesis and progression of DES in this population.

Correlation analysis between the OSDI index and MGDI revealed a strong positive correlation in the main group (r=0.701). This indicates a close association between the severity of subjective symptoms and objective signs of MGD. As MGD severity increases, so do subjective complaints, underscoring the clinical importance of MGD as a major factor in DES development among military personnel.

Table 2

Correlation analysis between OSDI index and MGDI.

Group	Correlation with OSDI (r)
Main group (n=240)	0.701
Control group 1 (n=80)	0.524
Control group 2 (n=80)	0.116

In control group 1 (civilians with DES), a moderate positive correlation was observed (r=0.524), suggesting that subjective complaints were also related to MGD severity, though to a lesser degree than in military personnel. In control group 2, the correlation between the OSDI index and MGDI was weak and statistically insignificant (r=0.116).

The findings indicate that both the main group and control group 1 exhibit a significant relationship between MGD severity and patient complaints. The strongest correlation was found among military personnel, emphasizing the need for a comprehensive approach to diagnosing and managing DES in this population.

DISCUSSION

The results demonstrated a significantly more severe degree of meibomian gland dysfunction (MGD) in military personnel compared to the control groups. The average MG density in the main group was 28.6%, corresponding to moderate atrophy, whereas in control group 1 this value reached 51.4%, and in the healthy control group exceeded 70%. These findings indicate statistically significant differences between the main and control groups (p<0.05).

Significant differences were also observed in the Meibomian Gland Dysfunction Index (MGDI). Among military personnel, the average MGDI was 1.58±0.34 points, approaching the threshold for severe dysfunction. In contrast, the value in control group 1 was lower at 1.22±0.22 points, and in control group 2 it was 0.48±0.11 points, consistent with normal function.

Particular attention should be given to the strong positive correlation observed between symptom severity (OSDI index) and MGDI in the military group (r=0.701), indicating a direct relationship between subjective complaints and objective signs of MGD. Among civilians with DES symptoms, this relationship was less pronounced (r=0.524), and among healthy participants it was virtually absent (r=0.116).

Thus, MGD in military personnel manifests more severely in both anatomical and functional dimensions. This highlights the need for a specialized approach to the diagnosis and prevention of DES in the military environment, including regular ophthalmological monitoring and the use of advanced diagnostic technologies such as LacryDiag.

CONCLUSION

The data obtained indicate significantly more pronounced meibomian gland dysfunction in military personnel with DES symptoms compared to civilian individuals, as evidenced by both morphological (MG density of 28.6%) and functional (MGDI 1.58±0.34) parameters. The application of the LacryDiag method demonstrated high clinical relevance in the diagnosis of MGD.

REFERENCES

Abu EK, Ofori AO, Boadi-Kusi SB, Ocansey S, Yankah RK, Kyei S, Awuku AY. Dry eye disease and meibomian gland dysfunction among a clinical sample of type 2 diabetes patients in Ghana. Afr Health Sci. 2022 Mar;22(1):293-302. doi: 10.4314/ahs.v22i1.36.

Hisey EA, Galor A, Leonard BC. A comparative review of evaporative dry eye disease and meibomian gland dysfunction in dogs and humans. Vet Ophthalmol. 2023 Apr;26 Suppl 1(Suppl 1):16-30. doi: 10.1111/vop.13066.

Ozkan J, Majzoub ME, Coroneo M, Thomas T, Willcox M. Ocular microbiome changes in dry eye disease and meibomian gland dysfunction. Exp Eye Res. 2023 Oct;235:109615. doi: 10.1016/j.exer.2023.109615.

Sheppard J, Shen Lee B, Periman LM. Dry eye disease: identification and therapeutic strategies for primary care clinicians and clinical specialists. Ann Med. 2023 Dec;55(1):241-252. doi: 10.1080/07853890.2022.2157477.

Narang P, Donthineni PR, D'Souza S, Basu S. Evaporative dry eye disease due to meibomian gland dysfunction: Preferred practice pattern guidelines for diagnosis and treatment. Indian J Ophthalmol. 2023 Apr;71(4):1348-1356. doi: 10.4103/IJO.IJO_2841_22.

Sandford EC, Muntz A, Craig JP. Therapeutic potential of castor oil in managing blepharitis, meibomian gland dysfunction and dry eye. Clin Exp Optom. 2021 Apr;104(3):315-322. doi: 10.1111/cxo.13148.

Tian L, Gao Z, Zhu L, Shi X, Zhao S, Gu H, Xu G, Wang L, Dai H, Zhang H, Jin X, Ma K, Xu Y, Ma L, Pei C, Ke B, Krösser S, Zhang Y, Jie Y. Perfluorohexyloctane Eye Drops for Dry Eye Disease Associated With Meibomian Gland Dysfunction in Chinese Patients: A Randomized Clinical Trial. JAMA Ophthalmol. 2023 Apr 1;141(4):385-392. doi: 10.1001/jamaophthalmol.2023.0270.

Rolando M, Merayo-Lloves J. Management Strategies for Evaporative Dry Eye Disease and Future Perspective. Curr Eye Res. 2022 Jun;47(6):813-823. doi: 10.1080/02713683.2022.2039205.

Toyos R, Desai NR, Toyos M, Dell SJ. Intense pulsed light improves signs and symptoms of dry eye disease due to meibomian gland dysfunction: A randomized controlled study. PLoS One. 2022 Jun 23;17(6):e0270268. doi: 10.1371/journal.pone.0270268.

McCann P, Abraham AG, Mukhopadhyay A, Panagiotopoulou K, Chen H, Rittiphairoj T, Gregory DG, Hauswirth SG, Ifantides C, Qureshi R, Liu SH, Saldanha IJ, Li T. Prevalence and Incidence of Dry Eye and Meibomian Gland Dysfunction in the United States: A Systematic Review and Meta-analysis. JAMA Ophthalmol. 2022 Dec 1;140(12):1181-1192. doi: 10.1001/jamaophthalmol.2022.4394.