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ORIGINAL ARTICLE

Tear Film Changes After Dacryocystorhinostomy Using Ocular Surface Analyzer

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Abstract

Background: **Tear film experience some changes after dacryocystorhinostomy. Detecting these changes is mandatory to reach the proper treatment and good postoperative outcomes.**

Objective: **This study aims to detect changes in the tear film in patients after dacryocystorhinostomy (DCR) using ocular surface analyzer (OSA).**

Patients and methods: **Thirty eyes of twenty studied cases with primary developed nasolacrimal duct obstruction (PANDO) had been contained. They underwent DCR and tear film was assessed clinically, using OSA and shirmer test.**

Results: **The research found that lipid layer thickness (LLT) rose from 63.5 nm preoperative to (76.4 nm and 68.07 nm) at one and three months postoperative, respectively. However, tear meniscus height, noninvasive break up time, invasive break-up time (IBUT) and Schirmer's test were statistically significantly decreased ($P = 0.004$, 0.012, 0.009 and 0.007), respectively.**

Conclusion: **Normalization of aqueous tear volume after dacryocystorhinostomy (DCR) was observed using an ocular surface analyzer (OSA) by rise lipid layer thickness (LLT), and decrease in TMH, NIBUT, IBUT and Schirmer's test.**

Keywords: Dacryocystorhinostomy, Ocular surface analyzer, Tear

1. Introduction

The ocular surface is covered by thin fluid coating called a tear film. It is in charge of maintaining a smooth refractive surface that is necessary for vision, as well as the comfort of the ocular surface and immunological, mechanical, and environmental protection.[1]

By performing osteotomy and opening nasolacrimal sac into the nose, dacryocystorhinostomy creates functional conduit from the canaliculi into the nose. It can be carried out either externally or endonasally.[2]

Ocular surface analyzer (OSA) is an instrument which has been mounted in slit lamp tonometer hole. It has been made to perform all tear film examinations using an international grading scale, from evaluating the quality of tears to analysing meibomian glands. OSA has been a brand-new tool for doing in-depth, rapid structural analyses of the tear film on each individual layer, including lipid, aqueous, and mucin layers. In regard to the kind of insufficiency, OSA assists in determining which layers may be treated with particular therapy.[3]

2. Goal of the research

The goal of the current research is to detect changes in the tear film in patients after DCR using OSA.

3. Patients and methods

In this prospective, observational case series study, there are thirty (30) eyes of patients with primary acquired nasolacrimal duct obstruction before and after external dacryocystorhinostomy were included. They were recruited from the Ophthalmology Department, Faculty of Medicine, Al-Azhar University. In this study, Tear film changes in studied cases with primary acquired

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nasolacrimal duct obstruction after externalDCR were assessed clinically, using ocular surface analyzer (OSA) and Schirmer test.

Research had been accepted by Institutional Review Board (IRB)of Al-Azhar University Hospital.

Study follows the tenets of declaration of Helsinki, written informed consent had been got from each patient after explanation of procedure and possible risks.

This research's inclusion criteria were: patients with epiphora aged between 20 and 60 years. Patients with severe dry eye, eyelid malformation, active ocular disease, ocular trauma, or inflammation were excluded.

OSA was used to assess lipid layer thickness, noninvasive break up time and tear meniscus height (TMH). Breakup time (BUT) were also measured with invasive method by instillation of fluorescein dye and then examination of eye on slit lamp and then calculation of time in seconds until presence of 1st dry spots on surface of cornea.

The Schirmer test is carried out by inserting specific paper strip into lower eyelid. To stop eyes from tearing during test because of irritation from paper strips, topical anaesthetic eye drops were administered beforehand. Eyes are typically softly closed for 5 min. Atypical test results may come from closing one's eyes firmly or rubbing them while undergoing test. Papers were removed after 5 min, and amount of moistened paper was measured. After 5 min, there should be more than ten mm of wetness on filter paper, which indicates normal tear generation.

3.1. Statistical analysis

SPSS v23 statistical software was used for the statistical analysis. For quantitative variables that had a normally distributed distribution, descriptive statistics were computed. For parametric data, the 2-sided Chi-square, student t, and ANOVA tests had been performed as appropriate; for non-parametric variables, the Mann-Whitney U and Kruskal Wallis tests were utilised. $P < 0.05$ had been determined to be statistically significant level, whereas $P > 0.05$ had been determined to be statistically non-significant.

4. Results

In this study thirty eyes of twenty studied cases with primary acquired nasolacrimal duct obstruction (PANDO) had been contained. They had been 22 women (73.3%) and eight men (26.7%). The years old varied from 20 to 60 years with mean ± SD of 48.0 ± 12.13 years. The patient demographic characters are illustrated in Table 1, Fig. 1 and Fig. 2.

Table 1. Studied case's demographics of the two studied groups.

	Number (%)	χ^2	*P*
Sex		0.925	0.009*
Males	8 (26.7)		
Females	22 (73.3)		
Total	30 (100)		
Age (years):			
Range	20–60		
Mean	48.0 ± 12.13		
Race	30 (100)		

F, Fisher exact test; SD, standard deviation; χ^2, Chi square.
$P < 0.05$ = significant.

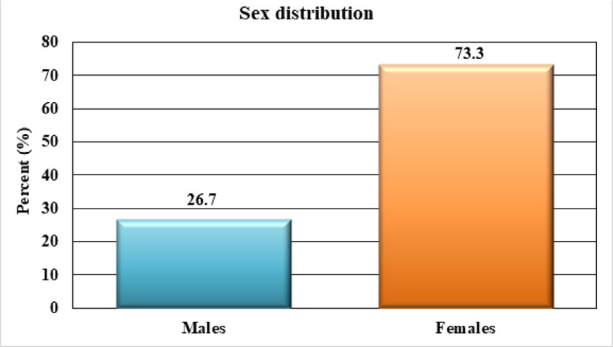

Fig. 1. Sex distribution of studied groups.

The study results showed that the lipid layer thickness (LLT) was increased from (63.5 nm) preoperative to (76.4 nm) postoperative at one month, ($P = 0.002$) which is statistically highly significant. The increase in LLT was measured but only to a statistically significant increase at (68.07 nm) at three months postoperative as shown in Table 2 and Fig. 3.

The tear meniscus height (TMH) was decreased from (0.36 mm) preoperative to (0.26 mm) postoperative at one month, ($P = 0.004$) which is statistically highly significant and decreased to (0.28 mm) postoperative at three months, ($P = 0.013$) which is statistically significant as shown in Table 2 and Fig. 4.

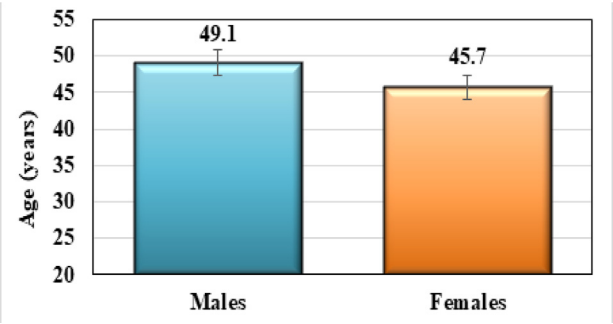

Fig. 2. Age of studied groups in mean ± SD.

Table 2. Comparing of tear parameters among preoperative and postoperative (1 and 3 months) after DCR.

	Range	Mean ± SD	t	*P*
LLT (nm)				
Preoperative	52–75	63.5 ± 6.25	Reference	
1 month postoperative	62–100	76.4 ± 10.17	0.952	0.002*
3 months postoperative	55–82	68.07 ± 8.27	0.346	0.025*
TMH (mm)				
Preoperative	0.19–0.5	0.36 ± 0.09	Reference	
1 month postoperative	0.17–0.37	0.26 ± 0.06	−0.774	0.004*
3 months postoperative	0.18–0.41	0.28 ± 0.07	−0.498	0.013*
NIBUT (sec)				
Preoperative	6.9–11.1	8.78 ± 1.11	Reference	
1 month postoperative	5.0–11.1	7.46 ± 1.35	−0.394	0.012*
3 months postoperative	5.2–10.9	7.44 ± 1.23	−0.385	0.022*
IBUT (sec)				
Preoperative	9–30	17.7 ± 5.40	Reference	
1 month postoperative	7–20	13.3 ± 3.73	−0.445	0.009*
3 months postoperative	7–19	12.9 ± 3.73	−0.458	0.008*
Schirmer's test (mm)				
Preoperative	9–26	15.7 ± 4.55	Reference	
1 month postoperative	5–24	11.8 ± 4.25	−0.469	0.007*
3 months postoperative	5–17	11.3 ± 3.08	−0.473	0.007*

*$P < 0.05$ = significant.
DCR, Dacryocystorhinostomy; IBUT, invasive break up time; LLT, lipid layer thickness; NIBUT, non-invasive breakup time; SD, Standard deviation; t, paired *t*-test; TMH, tear meniscus height.

Noninvasive break up time (NIBUT) was decreased from (8.78 s) preoperative to (7.46 s) postoperative at one month and to (7.44 s) postoperative at three months, ($P = 0.012$, 0.022, respectively) which is statistically significant as shown in Table 2 and Fig. 5.

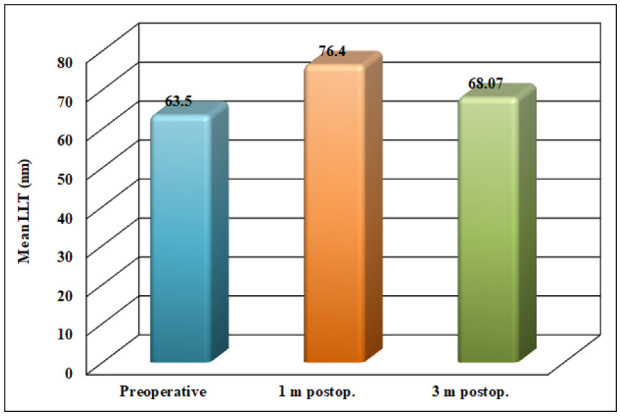

Fig. 3. Comparison between pre and postoperative lipid layer thickness (LLT).

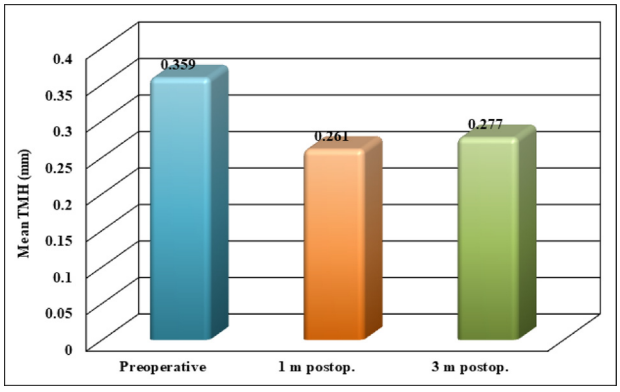

Fig. 4. Comparing among pre and postoperative tear meniscus height (TMH).

The invasive break up time (IBUT) was decreased from (17.7 s) preoperative to (13.3 s) postoperative at one month and to (12.9 s) postoperative at three months, ($P = 0.009$, 0.008, respectively) which is statistically significant as shown in Table 2 and Fig. 6.

Schirmer test was decreased from (15.7 mm) preoperative to (11.8 mm) postoperative at one month, ($P = 0.007$) which is statistically significant and to (11.3 mm) postoperative at three months, ($P = 0.007$) which is statistically significant as found in Table 2 and Fig. 7.

5. Discussion

The problem was the continuity of eye discomfort of the epiphora patients after undergoing dacryocystorhinostomy (DCR) surgery and its importance was to recognize the cause of this eye discomfort followed by this study which was conducted to detect changes in the tear film in patients after DCR using ocular surface analyzer (OSA). The study showed that lipid layer thickness (LLT) was increased from (63.5 nm) preoperative to (76.4 nm) postoperative at one month, ($P = 0.002$) which is

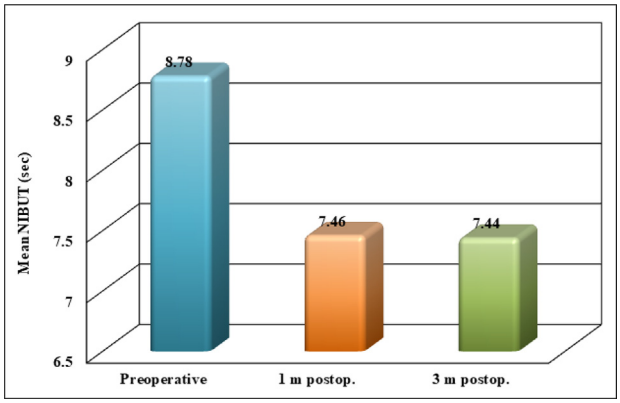

Fig. 5. Comparing among pre and postoperative noninvasive break up time (NIBUT).

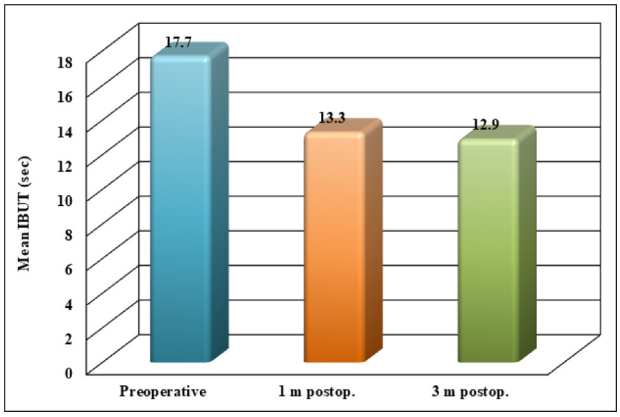

Fig. 6. Comparing among pre and postoperative invasive break up time (IBUT).

statistically highly significant. The increase in LLT was measured but only to a statistically significant increase at (68.07 nm) at three months postoperative but still significant compared to preoperative value.

These results in agreement with **Lee *et al.***[4] who investigated tear lipid layer and pre- and post-operative variations in studied cases with incompleteNLDO; preoperative LLT was 71.7 ± 30.9 nm increased to 91.6 ± 16.1 nm postoperatively with statistically significant difference of $P < 0.001$.

Because of NLD obstruction, there had been lot of tear liquid and lipid layer could stretch across entire area of cornea, which is why it tended to be thinner before DCR.[5] Although exact reason why lipid layer became thick after DCR is uncertain, **Kubo *et al.***[5] had considered subsequent options. 1st, following DCR, tear flow returned to normal, and studied case's advanced years old caused decrease in tear volume. Lipid layer on surface of cornea could not be expanded and grew thicker and more crooked than it had before DCR. 2nd, because there were fewer tears on cornea, tear spreading mechanism was unable to function. Tear film was said to be compressed while blinking, which caused aqueous decrease in aqueous-

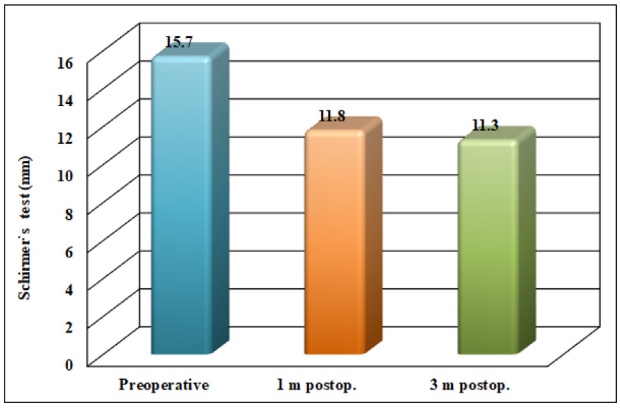

Fig. 7. Comparing among pre and postoperative Schirmer's test.

deficient studied cases and, as result, decrease in forward displacement of lid secretory lubricant.

Eom *et al.*[6] revealed that LLT in South Koreans is sixty five ±19.1 interferometry colour units, same value as that acquired with nanometer and having numeric value that is close to research's.

Since balance of components of tear film is crucial for tear film stability and compensating system is thought to be essential in response to variations in these components, lipid layer is raised during tearing to preserve homeostasis of tear composition.[7] As amount of tears reduces and lipid secretion does not alter right away, elevated postoperative LLT may be caused by maintained great lipid layer.

Current study also showed that tear meniscus height (TMH) was decreased from (0.36 mm) preoperative to (0.26 mm) postoperative at one month, ($P = 0.004$) which is statistically highly significant and decreased to (0.28 mm) postoperative at three months, ($P = 0.013$) which is statistically significant. This indicates that the TMH decreased markedly one month postoperatively, then increased gradually after three months but still significant compared to preoperative value.

These results agreed with the corresponding data of **Koh *et al.***[8] who observed a decrease in TMH from 0.595 ± 0.276 mm preoperatively to 0.288 ± 0.213 mm postoperatively with statistically greatly significant ($P < 0.001$), They showed that tear film instability caused by an excessive amount of tear film is related to impaired visual function in eyes with epiphora, and this led to an increase in tear drainage as indicated by reduction in tear meniscus diameters for studied cases with epiphora. i.e., TMH return to near normal levels after DCR.

In **Osawa *et al.***[9] study, which compared age-matched control group and NLDO group before surgery, NLDOgroup found greater TMH and TMA (tear meniscus area) values than those in control group.

Current study showed that noninvasive break up time (NIBUT) was statistically significantly decreased in comparison between preoperative (8.78 ± 1.11 s) and one month (7.46 ± 1.35 s) and three months (7.44 ± 1.23 s) postoperatively with statistically significant difference ($P = 0.01, 0.02$, respectively). This indicates that the NIBUT decreased after DCR. The current study showed that invasive break up time (IBUT) was statistically significantly decreased from preoperative (17.7 ± 5.4) to one month (13.3 ± 3.73) and three months (12.9 ± 3.73) postoperatively ($P = 0.009$, 0.008, respectively). This indicates that the IBUT decreased after DCR and tear film instability could be related to the low specificity of the TBUT.

In agreement with these data, **Kang *et al.***[10] found decrease in TBUT from (7.4 ± 4.0 s) preoperatively to

(6.9 ± 2.8 s) postoperatively however, they fail to find significance between them ($P = 0.051$).

Also, **Kim *et al.***[11] found that the mean BUT (8.2 ± 2.3 s) before DCR decreased to 6.99 ± 1.98 s one month postoperatively and further decreased to 6.27 ± 2.2 s 3 months postoperatively. Statistically it showed significant difference ($P = 0.04$, 0.03) in comparison between preoperative and 1 and 3 months postoperatively, respectively.

After DCR, noninvasive TBUT is increasingly frequently advised for the diagnosis of dry eye disease,[12] However, because screening tests were conducted at oculoplastic clinic, TBUT utilising fluorescein dye had been carried out in their research. It could be necessary to conduct more study on noninvasive TBUT screening standards.

Tear film normalization after DCR depend on tear osmolarity and composition of tear film that is primarily composed of electrolytes of aqueous phase of tear film. Electrolytes play important roles in epithelium health by homeostatic balance of tears.[13] Specifically, interactions between anionic phospholipids and divalent cations may alter structure of proteins.[14]

Our study showed that Schirmer's test was statistically significantly decreased in comparison between preoperative (15.7 ± 4.55 mm) and 1 (11.8 ± 4.25 mm) and 3 months (11.3 ± 3.08 mm) postoperatively ($P = 0.007$ for both comparisons). This indicates that the Schirmer's test significantly decreased after DCR.

In coordination with our data, **Kang *et al.***[10] found decrease in Schirmer's test from (17.5 ± 9.2 mm) preoperatively to (13.8 ± 8.6 mm) postoperatively, they found a highly significance between them ($P = 0.001$) like our study.

The study had some limitations: First, the low number of patients that interferes with the statistical accuracy, studies on large number of patients reflect more accurate statistical data. Second, the deficiency of control group for comparison with the patients group. Evaluation of studied cases with unilateral PANDO and enrollment of healthy eyes as control group might be more beneficial. Finally, the results should include idea about variations in tear osmolarity and ocular surface disease index score that is a valuable and beneficial tool in detection of tear film stability.

5.1. Conclusion

Normalization of aqueous tear volume after dacryocystorhinostomy (DCR) was observed using ocular surface analyzer (OSA) by increase lipid layer thickness (LLT), and decrease in TMH, NIBUT, IBUT and Schirmer's test.

Author contribution

Authors contributed equally in the study.

Authorship

All authors have a substantial contribution to the article.

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Conflicts of interest

The authors declare no conflict of interest.

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