Original Article

HEALTH SCIENCES
MEDICINE

DOI: 10.32322/jhsm.1105826
J Health Sci Med 2022; 5(4): 938-941

The recovery of ocular surface after bariatric surgery in morbid obese patients

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Cite this article as: Şahin Vural G, Çay F. The recovery of ocular surface after bariatric surgery in morbid obese patients. J Health Sci Med 2022; 5(4): 938-941.

ABSTRACT

Aim: To evaluate the alterations of the ocular surface in morbid obese patients after bariatric surgery.

Material and Method: The morbid obese patients who underwent sleeve gastrectomy surgery between February 2019 and September 2020 at Department of General Surgery in Balıkesir University Medicine Faculty were evaluated were evaluated in preoperative/postoperative 6th month period. The body-mass index (BMI), abdominal circumference (AC), Ocular Surface Disease Index (OSDI) questionnaire, tear osmolarity, Oxford ocular surface staining score, and Schirmer's test were performed. Preoperative and postoperative values were compared.

Results: The study included 68 eyes of 68 patients (33.76±9.85 years). The BCVA was improved from 0.98±0.11 to 1.00, the BMI was changed from 45.11±2.23 to 30.70±4.92 kg/m^2 ($p<0.05$) while AC was decreased from 134.97±6.07 to 109.38±6.26 cm ($p<0.05$) after surgery. In preoperative and postoperative period, OSDI was 12.33±20.57 and zero, tear osmolarity was 301.89±12.98 and 293.57±15.65 mOsm/L, Oxford grading was 0.42±0.69 and 0.04±0.20, Schirmer's test was 13.66±7.71 and 19.26±6.48 mm (in all, $p<0.05$), respectively. The change in BMI was correlated with postoperative tear osmolarity (r:0.251, p: 0.039), and T-BUT (r: -0.254, p: 0.037). In preoperative values, the preoperative BMI was correlated with OSDI scores and corneal staining score (r:0.292, r:0.388; $p<0.05$ respectively).

Conclusion: The decrease in BMI after surgery improves dry-eye disorder. Bariatric surgery is also crucial in the recovery of ocular surface parameters.

Keywords: Bariatric surgery, dry eye disorder, obesity

INTRODUCTION

Obesity is associated with increased morbidity and early mortality related to the increased prevalence of chronic diseases. There are more than 1 billion overweight adults and at least 300 million obese all over the world (1). Bariatric surgery is the most effective choice in weight loss and has been an increasing treatment modality in morbid obesity which is described as body mass index (BMI) >40 or ≥35 kg/m^2 when associated with comorbidities such as arterial hypertension, dyslipidemia, sleep apnea, or diabetes (2,3). The surgical approaches are described as malabsorptive (Roux-en-Y gastric bypass and biliopancreatic diversion with duodenal switch) or restrictive (adjustable gastric banding, sleeve gastrectomy) bariatric techniques. Sleeve gastrectomy is the most performed method because it is relatively easier, has fewer complication rates, and has shorter operation duration. After bariatric surgery, patients generally receive excessive lifestyle changes, loss of weight, and dietary restrictions. Also, the eye and ocular surface may be influenced by these alterations (4).

Obesity is known as a systemic inflammatory syndrome, and similarly dry eye syndrome (DES) is an inflammatory process of the ocular surface. The Study Group for Environmental Eye Disease showed that obesity is a risk factor for symptomatic DES (5). Although the effect of obesity on the ocular surface has been mentioned in previous studies (6,7), the effect of bariatric surgery is still unclear. In our opinion, obesity may cause ocular surface disorders, and the alterations in BMI after sleeve gastrectomy may improve ocular surface disturbances by recovering to a non-inflammatory process. The aim of this study is to compare the ocular surface alterations after bariatric surgery in morbid obesity patients.

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Received: 19.04.2022 **Accepted:** 09.05.2022

MATERIAL AND METHOD

The study was carried out with the permission of Balıkesir University Clinical Researchs Ethics Committee (Date: 09.10.2019, Decision No: 2019/136). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

In this prospective study, seventy-six (n:76) patients who have been diagnosed with morbid obesity (BMI >40 or ≥35 kg/m^2 when associated with comorbidities such as arterial hypertension, dyslipidemia, sleep apnea, or diabetes) and performed bariatric surgery between February 2019 and September 2020 at Department of General Surgery in Balıkesir University Medicine Faculty were evaluated. All procedures were performed adhered to the ethical rules and principles of the Helsinki Declaration. All participants were consulted to the department of ophthalmology for routine ophthalmic examinations at the immediate preoperative period and postoperative sixth months. The patients who have been performed sleeve gastrectomy were included while five patients who underwent Roux-en-Y gastric bypass and biliopancreatic diversion with duodenal switch were excluded. Three patients have not completed the follow-up period. Other exclusion criteria were being under the age of 18, history of the ocular surface disorder, previous ocular surgery, any type of topical or systemic (diuretics, antihistamines, vitamins, antidepressants, or anticholinergics) drug use and contact lens wear, history of keratitis, blepharitis, ocular trauma, patients with the corneal punctate epithelial erosion, accompanying systemic disease outside of obesity, Steven-Johnson syndrome, history of thermal/chemical/radiation damage. After strict exclusion criteria, the study included 68 eyes of 68 patients. All participants underwent a detailed ophthalmic examination including best-corrected visual acuity (BCVA), intraocular pressure (IOP), (TONOREF III, Nidek, Gamagori, Aichi, Japan), biomicroscopic examination, and non-dilated fundus examination. Firstly, the ocular surface disease index questionnaire (OSDI-includes 12 questions about the effect of dry-eye symptoms on life quality; Allergan, Irvine, California, USA) has been performed by themselves. Besides, tear osmolarity (quantified by TearLab Osmolarity System; San Diego, California, USA), tear break-up time (T-BUT), Oxford grading score of ocular surface staining (with Lissamine Green), and Schirmer's test was performed at preoperative and postoperative period. In each visit, BMI, abdominal circumference (AC), and follow-up period were recorded. The data obtained from patients in the pre&post operative period were compared.

Statistical Analysis

Statistical analysis was conducted using SPSS statistical software, version 23.0. Patient age and BMI were reported as means and Standard deviation and medians and range and compared by chi-quare tests. The gender distribution was reported by absolute and relative frequency. Mean OSDI scores, mean tear film BUT, Schirmer's and Oxford scores were reported by group means and standard deviation and medians and range and paired samples t-test. Results were shown for each value using tables. The tests were conducted with a significance level of 5%. The correlation between parameters was evaluated with Pearson correlation analysis.

RESULTS

In this study, 48 of the participants were female (70.5%) and 20 of them were male (29.4%). The mean age of the patients was 33.76±9.85 years. The BCVA was 0.98±0.11 preoperatively while 1.00 was in the postoperative period. In the preoperative period, the average BMI was 45.11±2.23 kg/m^2, and the AC 134.97±6.07 cm while the average BMI was decreased to 30.70±4.92 kg/m^2 ($p<0.05$), and the mean of AC was decreased to 109.38±6.26 cm ($p<0.05$) postoperatively. The average BMI change was 14.70±5.32 kg/m^2.

Ocular surface properties were summarized in **Table**. In Pearson correlation analysis, the change in BMI was significantly correlated with postoperative tear osmolarity (r:0.251, p: 0.039), and T-BUT (r: -0.254, p: 0.037). In preoperative values, the BMI was significantly correlated with OSDI scores and corneal staining score (r:0.292, r:0.388; $p<0.05$ respectively).

Table. The ocular surface properties in morbid obese patients in preoperative and postoperative period

	Preoperative	Postoperative	p value
OSDI	12.33±20.57	0	<0.05*
T-Osmolarity (mOsm/L)	301.89±12.98	293.57±15.65	<0.05*
T-BUT (sec)	8.35±13.61	13.61±2.46	<0.05*
Oxford grading	0.42±0.69	0.04±0.20	<0.05*
Schirmer's test (mm)	13.66±7.71	19.26±6.48	<0.05*

OSDI: Ocular Surface Disease Index Questionnaire Score, T-Osmolarity: Tear osmolartiy, T-BUT: Tear break-up time.
p value: Statistically significant ratio

DISCUSSION

In this prospective study, all ocular surface parameters were improved after sleeve gastrectomy. The changes in ocular surface properties after bariatric surgery were investigated in a few studies. These studies found any change in the ocular surface after surgery. Brandao et al. (8) compared the effect of sleeve gastrectomy and Roux en Y on ocular surface parameters, and they resulted that there was no significant change in ocular surface parameters between groups. Marques et al. (9) performed a dry eye-specific questionnaire, the tear ferning test, T-BUT,

Schirmer's test, ocular surface staining, and impression cytology before and after surgery. They resulted in any change in ocular surface parameters and evaluated the ocular surface up to 5 years after surgery compared with preoperative results. In our study, the participants were symptomatic in the preoperative period, the dry-eye symptoms were decreased after surgery.

The systemic inflammation and overactivity in the immune system were observed in obesity, and the amount of C-reactive protein and fibrinogen, the indicators of inflammation, has increased (10). The inflammation affects certain organs as well as the eyes. DED is defined as tear film instability, hyperosmolarity, ocular surface inflammation, and damage (11). The relationship between obesity and DED has been evaluated in several studies. In animal studies, Osae et al. (6) declared that meibomian gland hypertrophy and excessive tearing were found in obese mice that have fed with the high-fat diet, and associated dyslipidemia and obesity with altered meibum composition, a key feature of meibomian gland disease (MGD). Baser et al. (7) evaluated 92 polycystic ovarian syndrome (PCOS) patients with high BMI and compared the Schirmer's test, T-BUT, and OSDI with healthy subjects, and resulted that patients with high BMI are associated with tear film instability due to MGD. The animal studies showed that obesity may lead to corneal nerve degeneration and progression in corneal neuropathy independently of hyperglycemia. Besides, the alterations in corneal nerves can be used in the diagnosis of peripheric neuropathy in non-diabetic obese mice (12). They explained that it is still not certain how obesity impacts the ocular surface. The indicators related to inflammation were increased in obesity, and most of them are mainly produced by adipose tissue. (13–18). The incapacitated adipose tissue volume after bariatric surgery results in decreased inflammatory markers.

The tear osmolarity was significantly decreased after surgery. It is accepted as a gold standard quantitative method in the diagnosis of DED (18). The new description of DED includes increased tear inflammation, and the osmolarity is correlated with ocular surface inflammation. Even there was no significant correlation between ocular surface symptoms and the tear osmolarity in the preoperative period, and the mean of tear osmolarity was in the normal range (275-307 mOsm/L), and it was improved after surgery.

Brandao et al. (8) found T-BUT as 7.5 sec in patients who underwent sleeve gastrectomy at least 6 months ago. In our study, the average of T-BUT was 8.35 sec preoperatively and increased up to 13.61 sec postoperatively. This results that tear film integrity improves after bariatric surgery and indicated the recovery in meibomian gland activity. The effects of obesity on meibomian glands have been published in previous studies (7,20,21). Baser et al. (7) have indicated that there is a relationship between the increase of BMI and meibomian gland dysfunction, thus causing the development of dry eye disease. Additionally, lagophthalmos may exacerbate evaporative dry eye syndrome in obese patients. Lagophthalmos, especially in the night, is caused by floppy eyelid syndrome (FES) and obesity is one of the most important issues in FES (21). After surgery, both floppiness in eyelids may reverse, and symptoms disappear. We focused on dry-eye parameters so we were not recorded the lid laxity. For this reason, it is not possible to mention a certain relationship according to our results.

According to the OSDI questionnaire, 38.2% of the patients had dry-eye symptoms preoperatively. After surgery, OSDI was decreased and only two patients were still symptomatic. In previous studies, the OSDI questionnaire was applied to obese patients after bariatric surgery and reported as symptomatic in most of the patients (60.7%) (8). In a prospective study, Marques et al. (9) were evaluated 89 obese patients for about 12 months and resulted in no change in OSDI in the postoperative period. In the preoperative period, ocular hyperemia and complaints of a foreign body sensation were reported, but the complaints did not differ after surgery. The contrast in our study may be related to improvement in the quality of life following bariatric surgery (4). When patients feel satisfied with their general health status, the complaints may be decreased related to the ocular surface.

In this study, Schirmer's test showed that 60.2% of patients had decreased tear production and improved to 19.1% after surgery. This shows us that there is a failure in tear production in obese patients, and even the bariatric surgery and weight loss improve tear production, the patients still have low Schirmer's scores. The main source of tear production is the lacrimal gland. In obese patients, the inflammation in the lacrimal gland may be a component of systemic inflammation. The relationship between BMI and lacrimal gland inflammation has been investigated in previous studies (23) and has been claimed that inflammation (which directly affects the epithelium cells) may play an important role in the development of the DED. The commonly accepted opinion in the literature about the relationship between DED and obesity is inflammation (13–16). The immune homeostasis of the ocular surface is regulated with the balance of lymphocytes and anti-inflammatory factors such as IL-1 receptor antagonists, transforming growth factor (TGF)-β2, and matrix protease inhibitors like tissue inhibitors of metalloproteinase (TIMP)-1 (24). In the literature, there is not enough data about the change in the level of inflammatory mediators after bariatric surgery.

CONCLUSION

There are several mechanisms that are considered about ocular surface disorders in obesity, and the effect of bariatric surgery on the ocular surface is still controversial. According to our results, the decrease in BMI after bariatric surgery improves dry-eye disorder if Bariatric surgery is not only beneficial in weight loss, anatomical and physiological changes; it is also crucial in the recovery of ocular surface parameters. Further studies with larger-scaled patients should be designed with the inclusion of biochemical, histological, and functional parameters.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Balıkesir University Clinical Researchs Ethics Committee (Date: 09.10.2019, Decision No: 2019/136).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The author has no conflicts of interest to declare.

Financial Disclosure: The author declared that this study has received no financial support.

Author Contributions: The author declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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