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The effects of chalazion and the excision surgery on the ocular surface

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ABSTRACT

Purpose: To evaluate the effects of chalazion excision on the ocular surface, taking into account the subjective symptoms and the objective parameters of the tear film.
Methods: This prospective, interventional clinical study included 52 eyes from 26 patients with eyelid chalazion who underwent excision of the lesions between March and August 2022. Chalazion excision was performed on the patient's chalazion eye, and the contralateral eye served as the control. The following parameters were investigated both preoperatively and 1 week, 1 month, and 3 months postoperatively: the Ocular Surface Disease Index (OSDI), Schirmer I test, corneal fluorescein stain (CFS), tear meniscus height (TMH), noninvasive first breakup time (NifBUT), noninvasive average breakup time (NiaBUT), bulbar conjunctival redness score, the thickness of the lipid layer, and meibomian gland loss.
Results: Before surgery, the OSDI score of the chalazion eye was significantly higher than the contralateral eye. The bulbar conjunctival redness score ($p = 0.043$) and the OSDI score ($p = 0.004$) improved significantly in the first month after surgery. In the third month after surgery, the objective parameters showed significant improvements, including TMH ($p = 0.032$), NiaBUT ($p = 0.028$), bulbar conjunctival redness score ($p < 0.001$), the thickness of the lipid layer ($p = 0.021$), and meibomian gland loss ($p = 0.005$).
Conclusions: Our study revealed that chalazion excision can significantly improve the subjective symptoms and the objective tear film parameters of the ocular surface.

1. Introduction

Chalazion refers to a chronic lipogranulomatous inflammation of the meibomian glands in the eyelids [1]. The causes of chalazion include blepharitis, dry eye disease and, Demodex brevis [2]. Recent studies have shown that face mask wear is also emerging as a risk factor for chalazion [3]. Chalazion is a common eye disease that may affect various age groups. The incidence of chalazion has increased during the COVID-19 pandemic, reaching 0.151 in San Francisco in 2020 [3].

The meibomian glands secrete the meibum in tears, which is essential for maintaining the stability of the tear film [4]. One study showed that chalazion causes meibomian gland loss, which is unrelated to the treatment method but to the chalazion itself [5]. Chalazion also leads to an inflammatory state of the ocular surface [6]. The ocular surface inflammation and tear film instability are crucial contributors to the pathogenesis of dry eye disease [7]. According to tear film and ocular surface society (TFOS) dry eye

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workshop (DEWS) II diagnostic methodology subcommittee, dry eye disease is defined as a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film, and accompanied by ocular symptoms [8]. Patients with chalazion often report ocular surface discomfort, and we hypothesize that the symptoms may be attributed to dry eye disease caused by chalazion. The OCULUS Keratograph is a non-invasive ocular surface examination device that can provide data including parameters of the meibomian glands, non-invasive tear film break-up time, and the tear meniscus height in a short examination time. Therefore, it is widely used in the diagnosis and clinical evaluation of dry eye disease [9].

Surgical excision is the most commonly used and most effective treatment for chalazion, accounting for more than 80% of outpatient surgery. The mechanical damage to the meibomian glands and postoperative inflammation may worsen the ocular surface symptoms of patients. Whether chalazion excision is effective in ocular surface discomfort remains unclear. In this study, we evaluated postoperative ocular surface data in patients with chalazion and compared these data with preoperative and controls.

2. Methods

2.1. Subjects

This study was conducted in the Department of Ophthalmology, The Affiliated Drum Tower Hospital, Medical School of Nanjing University between March and August 2022. This study was approved by the local ethics committee (SC202200102, 2022.04.14), and the Declaration of Helsinki was followed. All patients signed written informed consent forms after being apprised of the study's details.

Patients with chalazion in a single eyelid who were willing to undergo surgery were included in the study. The contralateral eye of the included patients served as the control. All patients underwent routine preoperative examinations, including electrocardiograms, blood tests, best corrected visual acuity (BCVA), slit-lamp biomicroscopic examination, tonometry, and dilated fundus examination. The exclusion criteria are as follows: (1) Patients with a history of eye surgery; (2) Patients with active ocular inflammation or systemic inflammatory disease; (3) Patients with systemic diseases that can cause dry eye disease, such as diabetes and Sjögren's syndrome; (4) Patients taking systemic medications that can cause dry eye disease; (5) Patients with a history of ocular conditions other than refractive error; (6) Uncooperative patients or patients with psychiatric disorders.

3. Examinations

We used questionnaires to collect the sociological characteristics of the patients. All enrolled patients were examined at the outpatient service preoperatively, and 1 week, 1 month, and 3 months postoperatively. The examinations included: slit-lamp biomicroscopic examination, the Ocular Surface Disease Index (OSDI) score, Schirmer I test, corneal fluorescein stain (CFS), tear meniscus height (TMH), noninvasive first breakup time (NifBUT), noninvasive average breakup time (NiaBUT), bulbar conjunctival redness, the thickness of the lipid layer, and meibomian gland loss. The above examinations were performed by an experienced doctor.

The OSDI score was used to assess the subjective symptoms of the ocular surface. To better adjust to the Chinese language expression and cultural background, we used a questionnaire applicable to the Chinese population [10]. The questionnaire consists of 12 questions and is divided into three parts, the sum of which is the final score. TMH, NifBUT, NiaBUT, bulbar conjunctival redness, the thickness of the lipid layer, and meibomian gland loss were evaluated by a masked technician using the OCULUS Keratograph 5 M (Wetzlar, Germany) in a dark room with 25 °C temperature and 30% humidity. The operation was carried out according to the protocols provided by OCULUS. Schirmer I test and corneal fluorescein stain (CFS) were performed after the OCULUS Keratograph test to reduce the impact of the tests on the tear film. According to TFOS DEWS II criteria, dry eye disease was diagnosed when the patients reported ocular surface discomfort such as eyes are sensitive to light, sore eyes with an OSDI score $\geq$13 and any 1 sign: abnormal TBUT or abnormal ocular surface staining [8].

3.1. Chalazion excision

All the excision surgeries were performed by an experienced surgeon (Dr. Kai Hu). The operative eyes were anesthetized topically using oxybuprocaine hydrochloride eye drops and local infiltration anesthesia with 2% lidocaine. The chalazion was localized with chalazion forceps, and the eyelid was turned over. The conjunctiva of the eyelid was cut vertically by a scalpel. The contents and capsule of the chalazion were removed entirely. Instead of sutures, pressure was applied to the eyelid for 20 min to stop the bleeding. Ofloxacin eye ointment was applied to the conjunctival capsule, and the eyes were bandaged. The ointment was continuously applied for the following three days.

3.2. Statistical analysis

All statistical analysis was performed using SPSS (IBM, Somers, NY, version 26.0). Each value was presented using mean $\pm$ standard deviation. Firstly, we checked the compatibility of the data with normal distribution. For data that followed a normal distribution, paired sample T-test was used to compare the differences between preoperative and postoperative parameters, and one-way ANOVA was used to compare the differences between three or more groups. For data that did not follow a normal distribution, the nonparametric test was used to determine differences between two or more groups.

4. Results

52 eyes from 26 patients (19 women and 7 men) with chalazion were procured for this study, with 26 eyes that underwent excision surgery as the experimental group and 26 contralateral eyes as the control group. The average age of the patients was 33.54 ± 14.47 years (range, 18–71). The chalazion was located in the right upper eyelid of 9 patients, the left upper eyelid of 8 patients, the right lower eyelid of 4 patients, and the left lower eyelid of 5 patients. The average time patients complained of discomfort was 2.81 ± 4.56 months (range, 0.5–24). Two patients reported eyelid edema after surgery. There were no patients relapsed during follow-up. No patient developed a postoperative hematoma.

Before surgery, patients reported more discomfort and higher OSDI scores in the chalazion eyes than in the contralateral eyes ($p = 0.004$). One week after surgery, there was no significant change in the OSDI scores of the operative eye. However, the postoperative OSDI scores at one month ($p < 0.001$) and three months ($p < 0.001$) after surgery decreased significantly than the preoperative scores. There was no significant difference in the CFS scores between the chalazion and the control eyes before surgery. Three months after surgery, the CFS score was significantly reduced ($p = 0.016$) (Fig. 1).

OCULUS Keratograph was used to evaluate the baseline ocular surface parameters of the patients, and higher meibomian gland loss scores were found in the chalazion eyes. Analysis of other parameters did not reveal significant differences between the two eyes preoperatively. There were no significant changes in the parameters in the first week postoperatively. In the first month after surgery, the bulbar conjunctival redness score decreased significantly ($p = 0.043$). In the third month after surgery, various parameters showed improvements, including TMH ($p = 0.032$), NiaBUT ($p = 0.028$), bulbar conjunctival redness score ($p < 0.001$) (Fig. 2), the thickness of the lipid layer ($p = 0.021$), and meibomian gland loss ($p = 0.005$). The average values of each parameter are shown in Table 1. Before surgery, 16 chalazion eyes and 9 contralateral eyes were diagnosed with dry eye disease. At 1 week, 1 month and 3 months after surgery, there were 12, 9 and 6 operated eyes were diagnosed as dry eye disease, respectively.

5. Discussion

This is a prospective study to show that chalazion excision surgery significantly improved subjective symptoms and objective ocular surface parameters in patients with chalazion. We evaluated 9 ocular surface parameters preoperatively, and 1 week, 1 month, and 3 months postoperatively. Our results revealed that chalazion excision not only had a therapeutic effect on chalazion but also improved the associated dry eye disease.

Hanna S et al. studied the effect of chalazion surgery on the meibomian gland loss and morphology as well as dry eye syndrome [11]. Their results showed that the chalazion surgery restored the meibomian glands architecture signifcantly, and showed the improvements in the clinical and dry eye syndrome parameters. The conclusions of our study are consistent with Hanna S et al.: the surgery will not cause the loss of meibomian glands, and can improve both the subjective symptoms and the objective parameters of the ocular surface.

Consistent with clinical experience, our results demonstrated that patients with chalazion suffered more ocular surface discomfort. Surgery can relieve eye discomfort and dry eye disease caused by chalazion. It has been reported in some studies that ocular surgeries are associated with a higher incidence of postoperative dry eye disease [12]. During surgical procedures, manipulation of the ocular

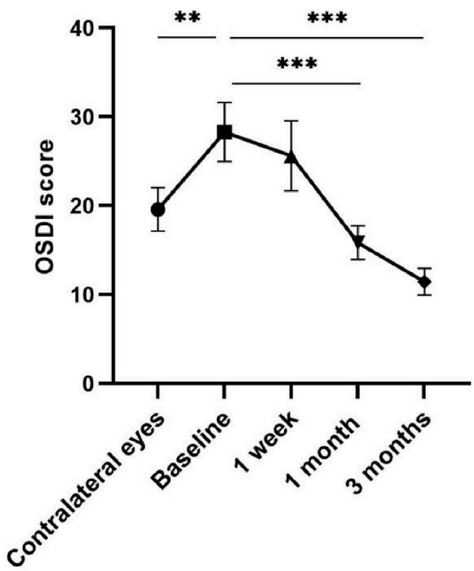

Fig. 1. The Ocular Surface Disease Index (OSDI) score of patients before surgery and 1 week, 1 month, and 3 months after surgery. Data are means ± SEM (n = 26). * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$ versus baseline.

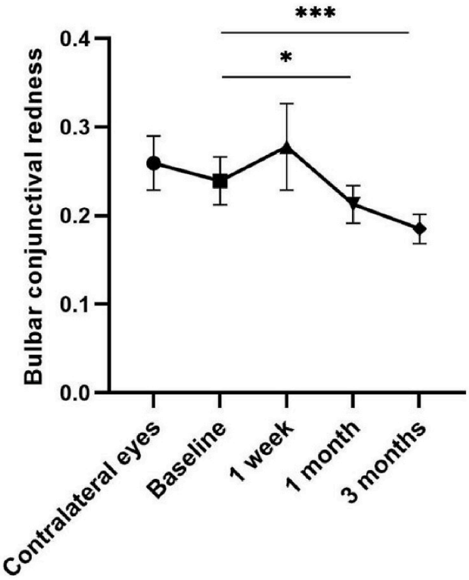

Fig. 2. The bulbar conjunctival redness of patients before surgery and 1 week, 1 month, and 3 months after surgery. Data are means ± SEM (n = 26). *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$ versus baseline.

Table 1
Changes of parameter before surgery and 1 week, 1 month, and 3 months after surgery.

Parameters		OSDI score	CFS score	TMH (mm)	NifBUT (s)	NiaBUT (s)	Bulbar conjunctival redness	Thickness of the lipid layer (nm)	Meibomian gland loss
contralateral eyes		19.59 ± 12.5	0.11 ± 0.21	0.20 ± 0.06	9.35 ± 5.38	12.12 ± 5.26	0.26 ± 0.16	1.54 ± 0.65	1.01 ± 0.617
Baseline		28.30 ± 16.98	0.35 ± 0.92	0.20 ± 0.06	8.89 ± 5.88	11.38 ± 5.68	0.24 ± 0.14	1.54 ± 0.81	1.34 ± 0.663
1 week		25.62 ± 20.11	0.28 ± 0.69	0.22 ± 0.06	8.80 ± 5.41	12.04 ± 5.12	0.28 ± 0.25	1.38 ± 0.57	1.24 ± 0.638
1 month		15.85 ± 9.70	0.11 ± 0.29	0.20 ± 0.05	8.94 ± 5.13	12 ± 4.72	0.21 ± 0.11	1.38 ± 0.57	1.20 ± 0.61
3 months		11.45 ± 7.69	0.03 ± 0.16	0.22 ± 0.06	10.19 ± 4.2	13.52 ± 3.85	0.19 ± 0.08	1.19 ± 0.4	1.13 ± 0.59
p value	Baseline versus contralateral eyes	0.004	0.286	0.18	0.461	0.477	0.459	1	0.09
	Baseline versus 1 week	0.508	0.856	0.166	0.936	0.517	0.722	0.305	0.228
	Baseline versus 1 month	0	0.121	0.83	0.732	0.619	0.043	0.157	0.191
	Baseline versus 3 months	0	0.016	0.032	0.062	0.028	0	0.021	0.005

OSDI, the Ocular Surface Disease Index; CFS, corneal fluorescein stain; TMH, tear meniscus height; NifBUT, noninvasive first breakup time; NiaBUT, noninvasive average breakup time.

surface, prolonged microscopic light exposure time, and use of antiseptics reduce tear film stability [13]. A reduction of goblet cells and inflammation of the ocular surface are also observed after eye surgeries [14–16]. For the above reasons, the patient's dry eye disease usually deteriorates after surgery. However, our results showed no statistical difference in the ocular surface parameters in the first week after chalazion excision surgery compared with those before surgery. Chalazion excision did not worsen the patients' ocular surface assessments even in the short postoperative term. This could be attributed to the excision surgery's short operation time and the incision's location in the eyelid conjunctiva, which had less interference with the tear film.

Our results revealed that surgery did not lead to the loss of meibomian glands. The meibomian gland loss in the first month after surgery did not show significant differences from the values before surgery. Li et al. also found that chalazion causes meibomian gland loss and that chalazion excision did not result in the loss of meibomian glands [5]. Interestingly, despite the significant improvements in many parameters three months after surgery, the thickness of the lipid layer was reduced significantly. The reasons for this change are unclear and require future studies.

The OSDI questionnaire is the most commonly used tool to evaluate the subjective symptoms and the quality of life of patients with dry eye disease [17]. As a multifactorial disease, the symptoms, physical signs, and objective examination outcomes are often inconsistent [18,19]. Therefore, as an independent assessment, OSDI plays a crucial part in the evaluation of patients with ocular surface diseases. Before surgery, we found that the OSDI scores of the chalazion eyes were significantly higher than those of the contralateral eye. However, other objective examinations showed no differences between the two eyes preoperatively. One month after surgery, the OSDI scores were significantly lower than before surgery, while other objective parameters did not present significant changes. As a subjective symptom questionnaire, the OSDI scores are more sensitive in reflecting the disease severity of chalazion. The above results imply that the OSDI scores could be used extensively in the evaluation of chalazion.

Our results also showed significant improvements in the objective parameters three months after surgery, suggesting that chalazion excision surgery can improve dry eye disease effectively. The change occurred three months after the surgery rather than earlier periods, which is likely explained by the inflammatory state in the early postoperative period, damage caused by surgery, and the ongoing healing process of the incision wound. A study reported that postoperative dry eye disease peaked in the first month and partially recovered in the third month after surgery [16], which is consistent with the results of this study. The dry eye disease in the early postoperative period may be related to the abuse of preservative eye drops, which has been demonstrated by some studies [20,21]. Several studies have also reported that surgery can reduce the compression of the cornea by chalazion, resulting in decreased corneal aberrations and densitometry values, and lower intraocular pressure (IOP) of the cornea [22,23]. Thus we hypothesized that the improvements in dry eye disease after chalazion excision could be linked to the relief of the compression of the cornea by chalazion.

This study had the following limitations: First, the present study is limited by its small sample size, and a larger sample size is needed to further validate our conclusions. Second, the follow-up time for this study was three months, and more extended follow-up periods are required to observe the long-term effects of the surgery. Finally, the reasons for the improvements in postoperative dry eye disease still need to be fully elucidated. Further studies, such as corneal confocal microscopy, are needed to clarify the underlying causes.

In conclusion, chalazion excision surgery did not worsen the dry eye disease of the chalazion patients and improved both the subjective symptoms and the objective parameters of the ocular surface. Our study supports excision surgery as a safe and effective treatment for chalazion.

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Author contribution statement

Rongjie Guo: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Jiaxuan Jiang: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

Yanan Zhang: Performed the experiments.

Qi Liang: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Jiao Liu: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Kai Hu: Funded and supervised the study.

Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.heliyon.2023.e19971.

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