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ORIGINAL PAPER

The effects of chalazion surgery on intraocular pressure and corneal topography

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Abstract
Purpose To evaluate the effects of chalazion surgery on intraocular pressure (IOP) and the biomechanical, topographic, and topometric properties of the cornea.
Methods A total of 29 patients with upper eyelid chalazion were included in this study. All patients underwent preoperative and postoperative detailed ophthalmological examinations including scale of chalazion size; IOP (IOPcc and IOPg), corneal hysteresis, and corneal resistance factor measurements using ocular response analyser (ORA; Reichert Instruments, Depew, NY, USA); topographic and topometric properties of the cornea using Pentacam HR (Oculus GmbH, Wetzlar, HE, Germany). Preoperative and postoperative measurements were compared.
Results The mean age of the patients was 29.07 ± 13.74 years (18–54 years). The mean IOPcc was 15.82 ± 4.20 mmHg preoperatively and 14.72 ± 3.96 mmHg postoperatively, and the mean IOPg was 15.21 ± 3.91 mmHg preoperatively and 14.21 ± 4.02 mmHg postoperatively ($p = 0.020$, $p = 0.007$, respectively). The mean central keratoconus index (CKI) was 1.006 ± 0.01 preoperatively and 1.002 ± 0.01 postoperatively ($p = 0.035$). Other biomechanical, keratometric, topographic, and topometric parameters were similar before and after the surgery (all $p > 0.05$).
Conclusion To the best of our knowledge, this is the first report to suggest that IOP and CKI are decreased after the removal of upper eyelid chalazion.

Keywords Chalazion · Ocular response analyzer (ORA) · Corneal topography · Pentacam

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Introduction

Chalazion is one of the most prevalent eye diseases. Painless swelling, ptosis, cosmetic disfigurements, and narrow eyelid aperture are the common complaints of patients and clinical findings of the disease. Obstruction of the meibomian gland associated with non-infectious lipogranulomatous inflammation is the primary pathophysiological mechanism [1–3]. Meibography studies show the obstruction of around 5–10 meibomian glands at the site of chalazion [4]. Neutrophils, plasma cells, lymphocytes, histiocytes, and giant cells around central extravasated lipid material participate in this inflammation [5]. Chronic blepharitis, rozasea and meibomian gland dysfunction are considered to be chalazion-related diseases, and the presence of these diseases increases the risk of

chalazion recurrence [6]. Conservative management of chalazion includes eyelid hygiene, hot compress, topical antibiotics, and steroids. Despite the availability of several minimal invasive treatment strategies such as intralesional steroid or botulinum toxin injections, chalazion constitutes a significant part of ophthalmological surgeries [7].

Although chalazion is a very common eye disease, clinical trials about the effects on the cornea and anterior segment are limited (only 15 clinical trials were found in PubMed after searching with "chalazion" MeSH term). To fill this gap, the aim of this study was to evaluate the effects of chalazion surgery on intraocular pressure (IOP) and the biomechanical, topographic, and topometric properties of the cornea.

Methods

This prospective study was conducted at a single tertiary hospital between January 2014 and September 2014. The study followed the tenets of the Declaration of Helsinki and was approved by the local ethics committee. After information about the study was provided verbally, written informed consent was received from all patients.

This study included 29 patients who presented at our clinic for chalazion surgery without any other ocular diseases except for refractive error and blepharitis. All the chalazions presented as a single solid nodule in the central part of the upper eyelid and remained for at least 1 month without any change in size. All patients underwent preoperative detailed ophthalmological examinations including best corrected visual acuity (BCVA) testing with a Snellen chart for far vision, slit-lamp examination, scale of chalazion size, measurements of IOP, and biomechanical, topographic, and topometric properties of the cornea.

The bulge of chalazion was marked using a pen in four quadrants, and diameters were scaled as vertical and horizontal. The longer diameter was defined as the size of the chalazion, and it was recorded preoperatively.

The IOP and biomechanical properties of the cornea were examined with an ocular response analyser (ORA; Reichert Instruments, Depew, NY, USA). ORA gives 2 measurements of IOP, which are corneal-compensated IOP (IOPcc) and Goldmann-correlated IOP (IOPg). In additional, ORA measures corneal hysteresis (CH) and corneal resistance factor (CRF) objectively. CH is considered as an indicator of corneal viscosity, and CRF is considered to be an indicator of the overall resistance of the cornea which is associated with the elastic properties of the cornea [8].

The corneal topography values were obtained automatically with Pentacam HR (Oculus GmbH, Wetzlar, HE, Germany). Pentacam HR software calculates the corneal and anterior chamber parameters according to three-dimensional image of the cornea and anterior segment [9]. This imaging using the Scheimpflug system provides the flattest (K_1), the steepest (K_2), and the mean keratometric values (K_m) at the front and back of the cornea, corneal thickness and volume, and anterior chamber depth. Pentacam HR software also provides important corneal topometric indexes such as the index of surface variance (ISV), index of vertical asymmetry (IVA), keratoconus index (KI), central keratoconus index (CKI), index of height asymmetry (IHA), and index of height decentration (IHD).

After standard uneventful chalazion surgery including incision, curettage, and capsule removal, patients were discharged with bacitracin ophthalmic ointment (Thiocilline, Abdi Ibrahim Ilac, Istanbul, Turkey) and bandage application for 3 h. Topical tobramycin + loteprednol eye drop (Zylet, Bausch & Lomb Pharmaceuticals, NJ, USA) were prescribed for postoperative use from day 1 to 10. Operation-related complications such as hemorrhage, severe pain, or poor wound healing were not observed in the postoperative examinations. One month later, the same detailed ophthalmological examinations were repeated and the measurements taken on ORA and Pentacam HR were compared with the preoperative values.

Statistical analyses were applied using the Statistical Package for the Social Sciences (SPSS) 22.0 software (IBM Corp., NY, USA). The results were presented as mean ± standard deviation of the mean. The normality of the numerical data was evaluated using the Kolmogorov–Smirnov test, and it was found that the numerical data did not conform to normal distribution. The Wilcoxon test was used for comparing 2 related samples including the preoperative and postoperative values of ORA and Pentacam HR. A

value of $p < 0.05$ was considered statistically significant.

Results

The study included 29 eyelids of 29 patients with chalazion. The mean age of the patients was 29.07 ± 13.74 years (18–54 years). The lesions were right-side in 14 cases and left-side in 15, and all chalazions were located in the central part of the upper eyelid. The mean duration of symptoms was 5.66 ± 0.94 months (1–24 months). The mean size of the chalazion was 6.21 ± 2.41 mm (2–14 mm), and BCVA for far vision was 20/20 in all patients preoperatively and postoperatively.

The mean IOPcc was 15.82 ± 4.20 mmHg preoperatively and 14.72 ± 3.96 mmHg postoperatively. The preoperative mean IOPg was 15.21 ± 3.91 mmHg and 14.21 ± 4.02 mmHg postoperatively. The postoperative IOPcc and IOPg were statistically significantly lower than the preoperative values ($p = 0.020$, $p = 0.007$, respectively). CH and CRF values were similar before and after the chalazion surgery ($p = 0.322$, $p = 0.289$, respectively). The mean preoperative and postoperative IOPcc, IOPg, CH, and CRF measurements are summarized in Table 1.

The mean CKI was 1.006 ± 0.01 preoperatively and 1.002 ± 0.01 postoperatively. This parameter was determined to have statistically significantly decreased after chalazion surgery ($p = 0.035$). When the other corneal topographic and topometric values were analyzed, keratometry, corneal thickness, corneal volume, anterior chamber depth, ISV, IVA, KI, IVA, and IHD were similar before and after the surgery (all $p > 0.05$). The mean preoperative and postoperative measurements of corneal topography are summarized in Table 2.

Table 1 The mean preoperative and postoperative IOPcc, IOPg, CH, and CRF measurements

	Preoperative	Postoperative	*p* value
IOPcc mmHg	15.82 ± 4.20	14.72 ± 3.96	0.020*
IOPg mmHg	15.21 ± 3.91	14.21 ± 4.02	0.007*
CH mmHg	10.26 ± 2.20	10.51 ± 1.59	0.322
CRF mmHg	10.28 ± 2.12	10.06 ± 1.69	0.289

IOPcc Goldmann-correlated intraocular pressure, *IOPg* Goldmann-correlated intraocular pressure, *CH* corneal hysteresis, *CRF* corneal resistance factor

Discussion

The most important finding of this study was the decrease in IOP after chalazion surgery. To explain this result is difficult, we have two different hypotheses. First, the presence of central upper eyelid chalazion increases the IOP. The upper eyelid tarsal plate are around 8–10 mm extending vertically and cover the corneal and supracorneal part of the scleral surfaces in an area of at least 7 and 100 mm^2, respectively, which can be simply calculated (when the upper eyelid cross limbus is at least 1.5 mm, π value is considered as 3) [10]. The gain of mass on this surface area creates a pressure according to basic physical principle ($P = G/S$; P: Pressure, G: Gain, and S: Surface area). One or more of the anterior chamber volume, iridotrabecular angle width, and episcleral venous resistance may be affected by this pressure transmitted through cornea, corneoscleral junction, and sclera. So, the IOP is affected directly from the mass increase in this contact area. The second hypothesis in this regard is that the presence of a central upper eyelid chalazion causes measurement error using non-contact tonometry. The ORA uses air pulse and light sensor, and records IOP at 2 applanation positions (inward and outward) [11]. The air pulse generates the force collapsing the central area of the cornea, and the light sensor perceives the position and elasticity of this field. The viscoelastic properties of the cornea cause 2 different measurements in the 2 different positions. According to the study results, removal of the central upper eyelid chalazion decreases the CKI. Therefore, the presence of the central upper eyelid chalazion caused central irregular steepness. This steepness may have enhanced the force needed to collapse the central area of the cornea and reduced the sensitivity of the light sensor. Conversion of the change in IOP by different IOP measurement techniques, especially Goldmann applanation tonometry, will be a more accurate approach.

Ben Simon et al. [12] reported a statistically insignificant increase in IOP after chalazion surgery. The findings of the current study completely conflict with this result, and this contradiction can be

Table 2 The mean preoperative and postoperative measurements of corneal topography

	Preoperative	Postoperative	*p* value
Front surface (D)			
K_1	42.89 ± 1.20	42.69 ± 1.15	0.307
K_2	43.82 ± 1.34	43.57 ± 1.26	0.108
K_m	43.33 ± 1.26	43.12 ± 1.19	0.190
Back surface (D)			
K_1	− 6.10 ± 0.24	− 6.06 ± 0.22	1.000
K_2	− 6.39 ± 0.29	− 6.35 ± 0.27	0.813
K_m	− 6.23 ± 0.27	− 6.20 ± 0.24	0.739
Central corneal thickness (μm)	544.38 ± 29.19	542.81 ± 20.77	0.148
Corneal volume (mm^3)	60.06 ± 3.55	59.82 ± 3.14	0.989
Anterior chamber depth (mm)	2.92 ± 0.33	2.91 ± 0.35	0.667
Corneal topometric indexes (in 8 mm zone)			
ISV	17.70 ± 5.09	17.76 ± 4.78	0.739
IVA	0.140 ± 0.07	0.138 ± 0.05	0.943
KI	1.018 ± 0.02	1.015 ± 0.02	0.714
CKI	1.006 ± 0.01	1.002 ± 0.01	0.035*
IHA	4.85 ± 4.27	4.59 ± 4.15	0.531
IHD	0.056 ± 0.21	0.010 ± 0.01	0.477

K_1, flattest keratometric value; K_2, steepest keratometric value, K_m, mean keratometric value; *ISV*, index of surface variance; *IVA*, index of vertical asymmetry; *KI*, keratoconus index; *CKI*, central keratoconus index; *IHA*, index of height asymmetry; *IHD*, index of height decentration (IHD)

explained in the following ways: (1) The sample of Ben Simon et al. consisted of chalazions in several locations of the upper and lower eyelids, but the current study sample consisted of only central upper eyelid chalazion, which was a more homogeneous sample than the other study. This difference may be important because the corneal contact area of a central upper eyelid chalazion is larger than that of a chalazion located elsewhere. (2) Ben Simon et al. did not mention the size of chalazion. However, the average diameter of the lesions in the current study sample was greater than half the corneal diameter, so it may be considered that the chalazions in this study were not small sized. If the lesions are really larger sized, the IOP increasing effect may be greater. (3) Ben Simon et al. did not specify the method of measurement of IOP. In the current study, IOP was measured with ORA and defined with 2 different parameters (IOPcc and IOPg). Therefore, there are many methodological differences between the 2 studies, and these differences should be considered when interpreting the results of this study.

A significant change in CKI was determined after chalazion surgery. Other corneal topographic and topometric parameters were similar both before and after surgery. The effect of chalazion on astigmatism has been studied by Nisted et al. a long time ago, and the association of chalazion and astigmatism has not been studied sufficiently during this time [13]. There is only one report in the literature about the corneal topographic effects of chalazion. Bagheri et al. reported significant changes in several topometric indexes such as surface regularity index, surface asymmetry index, and potential visual acuity [14]. These parameters are measured with different techniques and do not completely meet the topometric indexes of the Pentacam HR device. However, the study of Bagheri et al. is very important as it revealed the potential cause of corneal surface irregularity, and the current study supports those results even if limited. Further research is required to compare the effects of chalazion on corneal topography using different measuring devices to increase the knowledge of this subject.

The recognition of the effects of chalazion on the cornea and anterior segment is very limited. To the best of our knowledge, this is the first report to suggest that IOP and CKI values are decreased after the removal of a central upper eyelid chalazion. The verification of these findings with different measurement techniques in further studies will increase the reliability of the results.

Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

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