NORTHWESTERN MEDICAL JOURNAL

Northwestern Med J. 2026;6(2):174-180
DOI: 10.54307/NWMJ.2026.177

RESEARCH ARTICLES

Assessment of the effects of chalazion surgery on intraocular pressure measured by Goldmann applanation tonometry

Abdulkadir Küçük[1], Sevda Aydın Kurna[2], Cihan Kerekli[2], Ahmet Onat Yakalı[2], Eda Asılyazıcı[2]

[1]Department of Ophthalmology, Kadirli State Hospital, Osmaniye, Türkiye
[2]Department of Ophthalmology, University of Health Sciences, Fatih Sultan Mehmet Training and Research Hospital, İstanbul, Türkiye

Cite as: Küçük A, Aydın Kurna S, Kerekli C, Yakalı AO, Asılyazıcı E. Assessment of the effects of chalazion surgery on intraocular pressure measured by Goldmann applanation tonometry. Northwestern Med J. 2026;6(2):174-180.

ABSTRACT

Aim: We aimed to investigate changes in intraocular pressure (IOP) in patients who underwent chalazion surgery, specifically examining the impact of chalazion location, size, and site on the eyelid.

Materials and Methods: Forty eyes with chalazia were included in this prospective study. Chalazia were categorized based on size (Group 1: 3-5 mm; Group 2: >5 mm), location on the eyelid (central, temporal, nasal), and eyelid site (upper, lower). Before surgery, all patients underwent a comprehensive biomicroscopic examination, IOP measurement using both a pneumotonometer and a Goldmann applanation tonometer (GAT), and central corneal thickness (CCT) assessment. All measurements were repeated at the 1-month postoperative follow-up.

Results: Following chalazion surgery, a significant decrease in IOP was observed using both GAT (p=0.001) and pneumotonometry (p=0.035). No statistically significant difference was found between preoperative and postoperative CCT values (p=0.642). In Group 1 (3-5 mm), a significant postoperative decrease in IOP was observed (p=0.021). Furthermore, significant reductions in IOP measurements were noted in the upper eyelid group (p=0.003) and for centrally located chalazia (p=0.016). No significant correlation was found between changes in IOP measurements and changes in CCT.

Conclusion: Chalazia may influence IOP measurements, particularly those obtained via GAT. Therefore, IOP values measured in the presence of a chalazion should be interpreted with caution; repeating measurements after chalazion treatment may provide a more reliable clinical assessment.

Keywords: chalazion, Goldmann applanation tonometer, intraocular pressure, pneumotonometer

Corresponding author: Abdulkadir Küçük **E-mail:** akkucuk42@gmail.com
Received: 30.01.2025 **Accepted:** 30.03.2025 **Published:** 10.04.2026

INTRODUCTION

A chalazion is a common, benign lipogranulomatous eyelid lesion that can affect both children and adults (1). As a specific eyelid disease, chalazia are closely associated with meibomian gland dysfunction. The meibomian glands secrete meibum, which reduces tear film evaporation, facilitates ocular surface lubrication, and ensures a smooth optical surface (2). Meibography studies have demonstrated the obstruction of approximately 5-10 meibomian glands at the site of a chalazion (3). Treatment options include medical therapies—such as warm compresses, topical antibiotics, or ointments—as well as surgical incision and curettage, with or without intralesional triamcinolone injection (4). Incision and curettage are considered definitive treatments, although recurrences may occur (5). Chalazion excision surgery has been shown not to exacerbate dry eye disease and can improve both subjective symptoms and objective ocular surface parameters (6).

Chalazia can influence intraocular pressure (IOP) measurements. Several clinical studies have demonstrated that IOP fluctuates following chalazion surgery, exhibiting both downward and upward trends (7,8). Goldmann applanation tonometry (GAT) and pneumotonometry are standard methods for IOP measurement (9). GAT is currently recognized as the gold standard for measuring IOP (10). Pneumotonometry measures IOP using a probe with a small membrane tip that is applied to the cornea via air pressure (11). However, pneumotonometry has been reported as unreliable for measuring central corneal IOP in various ocular diseases (12). Furthermore, IOP measurements obtained via pneumotonometry have shown higher values in the periphery compared to central IOP (13).

This study aimed to investigate changes in IOP following chalazion surgery using both pneumotonometry and GAT, specifically analyzing the effects of chalazion location, size, and position on the eyelid.

MATERIALS AND METHODS

This study prospectively investigated the ocular findings of patients with chalazia who underwent surgical treatment. The study was approved by the Ethics Committee of İstanbul Fatih Sultan Mehmet Education and Research Hospital (No. FSM EAH-KAEK 2022/67) and adhered to the principles of the Declaration of Helsinki. Written informed consent and voluntary assent were obtained from all participants.

Forty patients undergoing chalazion surgery with no ocular diseases other than refractive errors were included. Surgical intervention was indicated for patients whose condition failed to improve after at least one month of standard treatment (bacitracin ophthalmic ointment and loteprednol/tobramycin eye drops). Topical loteprednol therapy was discontinued at least one week prior to baseline IOP measurements to minimize potential steroid-induced effects. Although preoperative short-term topical steroids were part of the standard protocol, no postoperative steroid therapy was administered.

Before surgery, all patients underwent a comprehensive ophthalmologic examination, including best-corrected visual acuity (BCVA) for distance, detailed biomicroscopic evaluation, CCT assessment, and IOP measurement via pneumotonometry and GAT. All tonometric measurements were performed by experienced ophthalmologists using a standardized protocol to minimize interobserver variability. Pneumotonometer measurements and CCT assessments were obtained using the Full Auto Tonometer TX-209 (Canon, Japan). The sequence of tonometric measurements was standardized: pneumotonometry was performed first, followed by GAT after a short interval. All measurements were repeated at the 1-month postoperative follow-up visit. To mitigate the influence of diurnal variation, preoperative and postoperative measurements were performed at approximately the same time of day. To further reduce measurement variability, the mean of at least three consecutive measurements was used for statistical analysis.

Chalazia were measured vertically and horizontally, with the largest diameter recorded (9). The study included chalazia measuring ≥3 mm (14). Lesions measuring 3-5 mm were categorized as Group 1, and those >5 mm as Group 2. Chalazia were further categorized into three groups based on location, central (Group 1), temporal (Group 2), and nasal (Group 3), as described by Park et al. (15). Patients were also assessed by the eyelid site: upper eyelid (Group 1) and lower eyelid (Group 2).

Chalazion excision was performed under local anesthesia using 40 mg/2 mL lidocaine hydrochloride + 0.025 mg/2 mL epinephrine (Lidofast, Vem, Turkey). The procedure involved eversion of the eyelid followed by a vertical incision. The contents and capsule were removed, and pressure was applied to achieve hemostasis. Antibiotic ointment was applied, and the eye was bandaged. Postoperatively, ointment was applied twice daily for five days.

Statistical analysis was conducted using SPSS version 26 (IBM Corp., USA). A significance level of $p < 0.05$ was established. Data normality was assessed using the Shapiro-Wilk test. Non-parametric tests were used to evaluate the effects of groups (size, location, and site) on pre- and postoperative measurement changes. Quantitative data comparisons were performed using the Mann-Whitney U and Wilcoxon tests for non-normally distributed data. IOP changes were calculated as postoperative minus preoperative values (ΔIOP). ΔIOP and ΔCCT were evaluated using Spearman's rank correlation coefficient. Categorical data were compared using the chi-square test.

RESULTS

Forty patients (25 males, 15 females) were included. The mean age was 39.73±15.55 years (range: 18-74 years). Chalazion size was 3-5 mm in 22 patients and >5 mm in 18 patients. In 25 patients, the chalazion was located on the upper eyelid, and in 15 patients, on the lower eyelid. Localization was temporal in 10 patients, central in 22, and nasal in 8. Preoperative and postoperative visual acuity was 20/20 in 18 patients and 20/25 in 2 patients.

The mean IOP measured by pneumotonometry was 14.98±3.19 mmHg preoperatively and 14.45±2.44 mmHg at 1 month postoperatively. The mean IOP measured by GAT was 14.90±2.56 mmHg preoperatively and 13.88±2.58 mmHg postoperatively. Postoperative IOP measured by pneumotonometry was significantly lower than preoperative values (p=0.035), and GAT measurements were also significantly lower (p=0.001).

The mean preoperative CCT was 557.25±33.97 µm, while the mean postoperative value was 555.85±29.84 µm. No statistically significant difference was observed (p=0.642).

Correlation analysis showed no significant association between the change in IOP measured by GAT (ΔIOP-GAT) and the change in CCT (ΔCCT) (Spearman r=-0.19, p=0.235). Similarly, no significant correlation was observed between ΔCCT and ΔIOP measured by pneumotonometry (Spearman r=0.22, p=0.174).

Table 1. Comparison of preoperative and postoperative measurements in two groups stratified according to the size of the chalazion

Measurements	Preoperative	Postoperative	P value
	Size 3-5 mm (Group 1)		
IOP (Pneumotonometry) mmHg	15.68±3.257	14.95±2.751	**0.038**
IOP (GAT) mmHg	15.36±2.555	14.41±2.823	**0.010**
	Size >5 mm (Group 2)		
IOP (Pneumotonometry) mmHg	14.11±2.968	13.83±1.886	0.380
IOP (GAT) mmHg	14.33±2.521	13.22±2.157	**0.021**

IOP: intraocular pressure, GAT: Goldmann applanation tonometer.

Table 1 shows the comparison of measurements stratified by chalazion size. In Group 1, pneumotonometer IOP decreased significantly (p=0.038), whereas no significant difference was found in Group 2 (p=0.38). In both groups, GAT-measured IOP showed a significant postoperative decrease (p=0.01 and p=0.021, respectively).

Table 2 displays measurements categorized by eyelid site. In Group 1 (upper eyelid), significant decreases were observed in both pneumotonometer (p=0.044) and GAT (p=0.003) measurements. In Group 2 (lower eyelid), no significant differences were observed (p > 0.05).

Table 3 presents measurements stratified by location. In Group 1 (central), a significant decrease in GAT-measured IOP was observed (p=0.016). In Group 3 (nasal), a significant decrease in GAT-measured IOP was also observed (p=0.04).

DISCUSSION

In this prospective study, we observed a statistically significant decrease in IOP measurements obtained by both GAT and pneumotonometry following chalazion excision. Notably, this reduction was not accompanied by a significant change in CCT and did not correlate with ΔCCT, suggesting that CCT-related measurement artifacts are unlikely to fully explain the findings. These results suggest that chalazia may influence IOP measurements through mechanical or biomechanical factors related to eyelid-globe interaction. However, as corneal biomechanical parameters were not directly evaluated, these mechanisms should be interpreted cautiously within the context of previous literature.

Table 2. Comparison of preoperative and postoperative measurements in two groups, stratified by the site of the chalazion

Measurements	Preoperative	Postoperative	P value
	Upper Eyelid		
IOP (Pneumotonometry) mmHg	14.63±3.173	13.88±2.271	**0.044**
IOP (GAT) mmHg	14.67±2.681	13.42±2.271	**0.003**
	Lower Eyelid		
IOP (Pneumotonometry) mmHg	16.0±3.063	15.86±2.143	0.572
IOP (GAT) mmHg	15.5±2.41	15.0±2.418	0.141

IOP: intraocular pressure, GAT: Goldmann applanation tonometer.

Table 3. Comparison of preoperative and postoperative measurements in three groups stratified by the location of chalazion

Measurements	Preoperative	Postoperative	P value
	Central		
IOP (Pneumotonometry) mmHg	14.45±3.67	13.86±2.436	0.115
IOP (GAT) mmHg	14.36±2.854	13.36±2.647	**0.016**
	Temporal		
IOP (Pneumotonometry) mmHg	16.3±2.214	16.1±1.853	0.493
IOP (GAT) mmHg	16.2±1.549	15.3±2.452	0.119
	Nasal		
IOP (Pneumotonometry) mmHg	14.75±2.55	14.0±2.39	0.161
IOP (GAT) mmHg	14.75±2.375	13.5±2.138	**0.040**

IOP: intraocular pressure, GAT: Goldmann applanation tonometer.

Given the absence of postoperative steroid therapy and stable CCT values, steroid-induced measurement bias is unlikely.

Ilhan et al. reported a postoperative decrease in IOP using an Ocular Response Analyzer and hypothesized that mechanical pressure from a chalazion could affect anterior chamber configuration and episcleral venous resistance (7). Physiologically, a chalazion is both a localized mass and a chronic inflammatory lesion that may alter eyelid tissue stiffness, orbicularis oculi tone, and blink dynamics. Such changes may generate sustained external compressive forces on the globe, particularly in the superior and central eyelid regions.

External eyelid compression may increase episcleral venous pressure (EVP) by mechanically impeding drainage. Because EVP constitutes the distal pressure of the conventional aqueous humor outflow pathway, subtle elevations in EVP can influence measured IOP without changes in aqueous production. This mechanism provides a plausible explanation for the reversible IOP changes observed after chalazion removal.

Ilhan et al. further emphasized that GAT measurements should be interpreted alongside corneal viscoelastic properties, as variations may reflect biomechanical factors (7). The cornea functions as a biomechanical transducer; increased eyelid pressure may alter corneal deformation during applanation, requiring greater force to achieve the standard applanation area and artificially elevating measured IOP.

Consistent with these considerations, studies have shown that chalazia can induce changes in corneal shape. Bagheri et al. reported significant alterations in refractive error and topography following excision, indicating that eyelid pressure modifies corneal curvature (16). Similarly, Santa Cruz et al. described chalazion-induced hyperopic shifts, and Cosar et al. demonstrated that chalazia may compromise visual outcomes even after refractive surgery (17,18). Recent investigations have shown improvements in corneal aberrations and densitometric parameters post-excision, alongside alterations in meibomian gland morphology (19,20). Experimental evidence confirms that the cornea exhibits viscoelastic behavior and responds dynamically to external forces, providing a basis for how eyelid pressure influences applanation-based IOP measurements (21).

Beyond mechanical factors, chalazia may influence IOP through the ocular surface microenvironment. Guo et al. demonstrated that chalazia are associated with tear film instability and inflammation, which can affect the cornea-tonometer interface (6). Tear film irregularity may modify applanation dynamics; postoperative normalization of the ocular surface may thus contribute to more stable and lower measured IOP values.

A chalazion is increasingly recognized as a chronic disorder. Evans et al. identified factors associated with recurrence and surgical intervention, supporting the concept of sustained tissue remodeling (1). Chronic inflammatory changes may increase eyelid stiffness and alter blink-induced globe compression, thereby modulating EVP. These mechanisms may account for the higher preoperative IOP measurements observed in specific subgroups.

Li et al. reported that chalazia and their treatments can induce persistent structural alterations in the meibomian glands (22). Lipid layer impairment may increase tear film breakup. In our study, the absence of CCT changes supports the interpretation that postoperative IOP differences reflect eyelid- and surface-mediated influences rather than intrinsic corneal structural changes.

Conversely, Ben Simon et al. observed a non-significant increase in IOP after surgery (8). The lack of detailed lesion characteristics in that study limits direct comparison. Variability in size, location, and inflammatory burden may result in heterogeneous degrees of episcleral venous compression, leading to inconsistent findings across studies.

The inclusion of subgroup analyses based on size and location allowed a detailed assessment of factors influencing IOP. Chalazia on the upper eyelid and those with central or nasal localization showed more pronounced postoperative changes. Given their proximity to the limbal episcleral venous network, these findings are consistent with mechanical and venous influences on tonometry.

Limitations include the modest sample size and one-month follow-up, suggesting the findings should be interpreted in an exploratory context. Diurnal variation was not strictly controlled, and corneal biomechanical parameters (e.g., hysteresis) were not assessed. Therefore, biomechanical explanations remain hypothesis-generating. Nevertheless, the prospective design and use of two tonometric techniques enhance the clinical relevance of the findings.

In conclusion, chalazia may influence IOP measurements, particularly those obtained via GAT. Accordingly, IOP values measured in the presence of a chalazion should be interpreted with caution, and reassessment after treatment may improve clinical reliability.

Ethical approval

This study has been approved by the Ethical Committee of İstanbul Fatih Sultan Mehmet Education and Research Hospital (approval date 11/08/2022, number FSMEAH-KAEK 2022/67).

Author contribution

Surgical and Medical Practices: AK, CK, AOY; Concept: AK, SAK; Design: SAK, EA; Data Collection or Processing: AK, CK, AOY; Analysis or Interpretation: AK, SAK; Literature Search: AK, EA; Writing: AK, SAK. All authors reviewed the results and approved the final version of the article.

Source of funding

The authors declare the study received no funding.

Conflict of interest

The authors declare that there is no conflict of interest.

REFERENCES

1. Evans J, Vo KBH, Schmitt M. Chalazion: racial risk factors for formation, recurrence, and surgical intervention. Can J Ophthalmol. 2022; 57(4): 242-6. [Crossref]
2. Knop E, Knop N, Millar T, Obata H, Sullivan DA. The international workshop on meibomian gland dysfunction: report of the subcommittee on anatomy, physiology, and pathophysiology of the meibomian gland. Invest Ophthalmol Vis Sci. 2011; 52(4): 1938-78. [Crossref]
3. Alsuhaibani AH, Carter KD, Abràmoff MD, Nerad JA. Utility of meibography in the evaluation of meibomian glands morphology in normal and diseased eyelids. Saudi J Ophthalmol. 2011; 25(1): 61-6. [Crossref]
4. Goawalla A, Lee V. A prospective randomized treatment study comparing three treatment options for chalazia: triamcinolone acetonide injections, incision and curettage and treatment with hot compresses. Clin Exp Ophthalmol. 2007; 35(8): 706-12. [Crossref]
5. Ben Simon GJ, Huang L, Nakra T, Schwarcz RM, McCann JD, Goldberg RA. Intralesional triamcinolone acetonide injection for primary and recurrent chalazia: is it really effective? Ophthalmology. 2005; 112(5): 913-7. [Crossref]
6. Guo R, Jiang J, Zhang Y, Liang Q, Liu J, Hu K. The effects of chalazion and the excision surgery on the ocular surface. Heliyon. 2023; 9(9): e19971. [Crossref]
7. Ilhan C, Ozgul Yilmazoglu M, Yilmazbas P. The effects of chalazion surgery on intraocular pressure and corneal topography. Int Ophthalmol. 2019; 39(5): 1055-9. [Crossref]
8. Ben Simon GJ, Rosen N, Rosner M, Spierer A. Intralesional triamcinolone acetonide injection versus incision and curettage for primary chalazia: a prospective, randomized study. Am J Ophthalmol. 2011; 151(4): 714-718.e1. [Crossref]
9. Rüfer F. Value of Pressure Measurements: Methods and Sources of Errors. Klin Monbl Augenheilkd. 2016; 233(7): 847-55. [Crossref]
10. Goldmann H, Schmidt T. Applanation tonometry. Ophthalmologica. 1957; 134(4): 221-42. [Crossref]
11. Wittenberg S. Evaluation of the pneuma-tonometer. Am J Optom Physiol Opt. 1978; 55(5): 337-47. [Crossref]
12. Lee JH, Sanchez LR, Porco T, Han Y, de Alba Campomanes AG. Correlation of Corneal and Scleral Pneumatonometry in Pediatric Patients. Ophthalmology. 2018; 125(8): 1209-14. [Crossref]
13. Kuo DS, Ou Y, Jeng BH, et al. Correlation of Serial Scleral and Corneal Pneumatonometry. Ophthalmology. 2015; 122(9): 1771-6. [Crossref]
14. Sabermoghaddam AA, Zarei-Ghanavati S, Abrishami M. Effects of chalazion excision on ocular aberrations. Cornea. 2013; 32(6): 757-60. [Crossref]
15. Park YM, Lee JS. The effects of chalazion excision on corneal surface aberrations. Cont Lens Anterior Eye. 2014; 37(5): 342-5. [Crossref]

16. Bagheri A, Hasani HR, Karimian F, Abrishami M, Yazdani S. Effect of chalazion excision on refractive error and corneal topography. Eur J Ophthalmol. 2009; 19(4): 521-6. **[Crossref]**

17. Santa Cruz CS, Culotta T, Cohen EJ, Rapuano CJ. Chalazion-induced hyperopia as a cause of decreased vision. Ophthalmic Surg Lasers. 1997; 28(8): 683-4.

18. Cosar CB, Rapuano CJ, Cohen EJ, Laibson PR. Chalazion as a cause of decreased vision after LASIK. Cornea. 2001; 20(8): 890-2. **[Crossref]**

19. Oncul H, Yildirim Y, Caglayan M, Dag U, Alakus MF. The effect of chalazion excision on corneal aberrometric and densitometric values. Beyoglu Eye J. 2021; 6(3): 191-9. **[Crossref]**

20. Fukuoka S, Arita R, Shirakawa R, Morishige N. Changes in meibomian gland morphology and ocular higher-order aberrations in eyes with chalazion. Clin Ophthalmol. 2017; 11: 1031-8. **[Crossref]**

21. Zeng Y, Yang J, Huang K, Lee Z, Lee X. A comparison of biomechanical properties between human and porcine cornea. J Biomech. 2001; 34(4): 533-7. **[Crossref]**

22. Li J, Li D, Zhou N, Qi M, Luo Y, Wang Y. Effects of chalazion and its treatments on the meibomian glands: a nonrandomized, prospective observation clinical study. BMC Ophthalmol. 2020; 20(1): 278. **[Crossref]**