



## Central Macular Thickness Change after Uneventful Small Incision Cataract Surgery -An Observational Study

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### ABSTRACT:

**Background** Cystoid macular edema (CME) following uneventful small incision cataract surgery is a well-known entity. The aim of present study was to assess the risk factors for CME following cataract surgery.

**Methods** The present hospital based observational study was conducted at department of ophthalmology of a tertiary care hospital among 100 patients diagnosed of cataract who underwent surgery during the study period of one year. OCT images were used to measure CME. Measurement was done pre-operatively and first, sixth and 12th week post follow up. **Results** The mean age of patients was  $60.45 \pm 21.03$  years. The number of female patients (60) was higher than male patients (40). The pre-operative mean visual acuity was found to be  $0.06 \pm 0.03$ , whereas the post-operative mean BCVA was found to be  $0.66 \pm 0.15$  at the first week,  $0.68 \pm 0.18$  at the sixth week,  $0.69 \pm 0.16$  at the 12th week follow-up. The average thickness of the macular edema before surgery was compared to the average thickness after 1 week, 6 weeks, and 12 weeks after surgery using a paired t-test. The results showed a statistically significant P value ( $<0.001$ ). **Conclusion** Even after a straightforward cataract surgery, there is a slight but detectable increase in the thickness of the macula, which is not clinically significant. The highest increase was found 6 weeks following the procedure, and it returned to almost normal levels within 3 months. The comparison of central macular thickness before and after the operation, namely during the first week, sixth week, and 12th week, indicates a strong association.

**Keywords:** Cataract, Central macular thickness, Surgery, Vision loss, Visual acuity.

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## 1. Introduction

Cataract is a leading cause of preventable blindness worldwide. Cataract surgery is the predominant surgical procedure conducted in the field of ophthalmology. Small-incision cataract surgery (SICS) and phaco-emulsification are the two most frequently conducted procedures for cataract removal. [1]

Cystoid macular edema (CME) is a commonly observed occurrence after cataract surgery, with a prevalence ranging from 0.2% to 20%. [2] The variation in incidence rates of clinical cystoid macular edema (CME) can be attributed primarily to advancements in modern phacoemulsification techniques and the specific diagnostic methods employed, such as slit-lamp biomicroscopy, optical coherence tomography (OCT), or fluorescein angiography. However, as a general range, the incidence of clinical CME with modern phacoemulsification techniques is estimated to be between 0.2% and 2.35%. [3] Irrespective of the actual occurrence of CME, this condition has been thoroughly researched and has well-known risk factors including diabetic retinopathy, retinal vein occlusions, epiretinal membranes, uveitis, complicated cataract surgery, and a previous history of retinal detachment repair. Nevertheless, there is a scarcity of research investigating the frequency and determinants of postoperative CME. [4-6]

Cystoid macular edema that occurs after surgery is believed to be caused by the disruption of the tight connections between the retinal vascular endothelial cells. [7] This results in the buildup and release of fluid outside of the cells in the macula due to an increase in the permeability of blood vessels. The macula is believed to have a higher likelihood of developing edema due to the loose interconnecting fibres in Henle's layer and the relatively low presence of Muller cells. [8]

Among the individuals who receive straightforward cataract extraction, only 20% experience angiographically confirmed cystoid macular edema (CME). [9] Nevertheless, approximately 1% of these eyes experience a noticeable decrease in visual acuity that is considered medically relevant. [10] In the event of difficulties arising during cataract extraction, such as the rupture of the posterior capsule, loss of vitreous, serious damage to the iris, or the pulling of vitreous at the site, there is a notable rise in the occurrence (up to 20%) of clinically observable cystoid macular edema (CME). The user's text is enclosed in tags. PCME, or pseudophakic cystoid macular edema, can be characterised as either angiographical, meaning it can be observed on fluorescein angiography, or clinical, meaning it is associated with a reduction in visual acuity. PCME is further classified as acute if it occurs within a period of 6 months, or chronic if it persists for over 6 months. [4]

Macular edema can also occur in situations of diabetic retinopathy, age-related macular degeneration, venous occlusion, hypertensive retinopathy, central serous chorioretinopathy, Irvin-Gass syndrome, pars planitis, uveitis and iridocyclitis, choroiditis, and retinitis pigmentosa [8]

There are several ways available to evaluate macular edema (ME). Conventional techniques for examination involve the use of contact and non-contact slit lamp biomicroscopy using 60D/78D/90D lenses, indirect ophthalmoscopy, fundus fluorescein angiography, and fundus stereo-photography. OCT has emerged as a crucial instrument in the diagnosis and treatment of retinal diseases, including CME. [11] The purpose of this research was to assess the risk factors for CME following cataract surgery.

## 2. Material and Methods

The present hospital based observational study was conducted at department of ophthalmology of a tertiary care hospital among patients diagnosed of cataract surgery during

the study period of one year. The ethical permission was taken from institutional ethics committee before commencement of study. Patients were asked to sign an informed consent form after explaining them the complete procedure.

Through consecutive sampling total of 100 patients diagnosed of cataract who underwent surgery were selected on the basis of inclusion and exclusion criteria.

### **Inclusion Criteria**

All patients received SICS (small incision cataract surgery) with the insertion of a posterior chamber intra-ocular lens. Any level of cataract that permits OCT to assess the thickness of the central macula, including patients who had a successful surgery called SICS with the placement of an intraocular lens in the posterior chamber.

### **Exclusion Criteria**

Patients with traumatic cataract, complex cataract, surgical complications, retinal or posterior segment disease, glaucoma, uveitis, previous intra-ocular surgery in the same eye, and uncontrolled hypertension/diabetes.

Comprehensive demographic, preoperative, intraoperative, and postoperative follow-up data at first sixth and twelfth week were gathered from each patient. The main focus was on the occurrence of post-operative cystoid macular edema (CME) at any moment after the surgery, as determined by OCT imaging.

CME was characterised as the presence of cystoid intraretinal fluid as observed on OCT. Fluorescein angiography was unnecessary for the diagnosis. The existence of CME was a dichotomous variable, indicating whether it was present or absent at any time following surgery. The OCT machine had no limitations, provided that it was a spectral-domain OCT unit and not a time domain unit.

The visual acuity (VA) before and after the surgery was measured using the best adjusted Snellen visual acuity during the appointment before the surgery and at the last follow-up visit after the surgery. The Snellen acuity was transformed into logMAR for the purpose of analysis. Findings were statistically analyzed using SPSS22.0. Data comparisons were made by using paired t-test.

### **3. Results**

The mean age of patients was  $60.45 \pm 21.03$  years. The number of female patients (60) was higher than male patients (40). The mean surgical time was  $10.40 \pm 1.27$  minutes. Right eyes were operated in 70 patients, and left eyes were operated in 30 patients (figure 1).

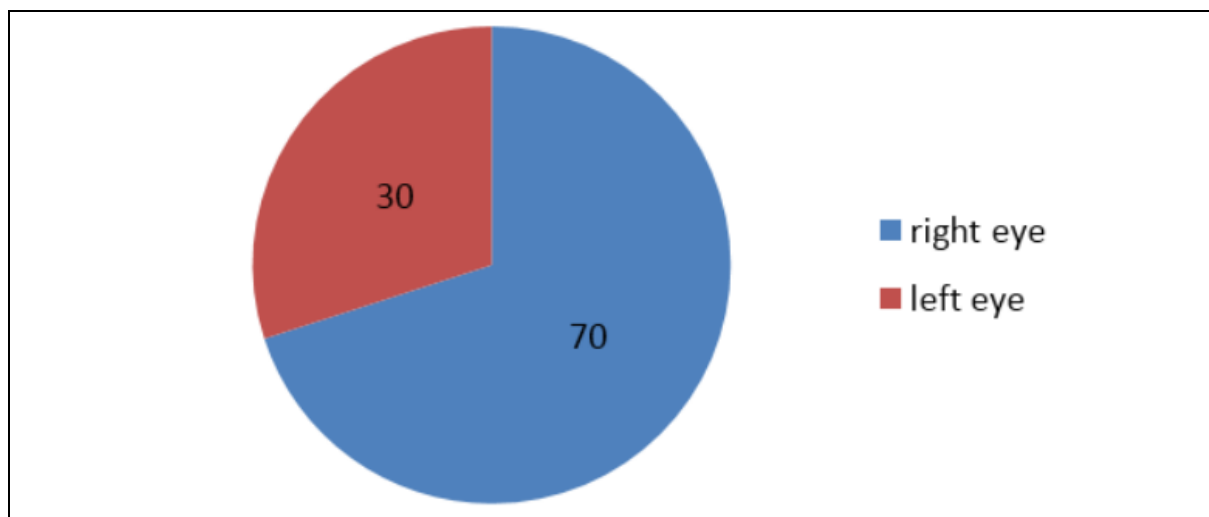


Figure 1: division of patients on the eye operated

The pre-operative mean visual acuity was found to be  $0.06 \pm 0.03$ , whereas the post-operative mean BCVA was found to be  $0.66 \pm 0.15$  at the first week,  $0.68 \pm 0.18$  at the sixth week,  $0.69 \pm 0.16$  at the 12th week follow-up as shown in figure 2.

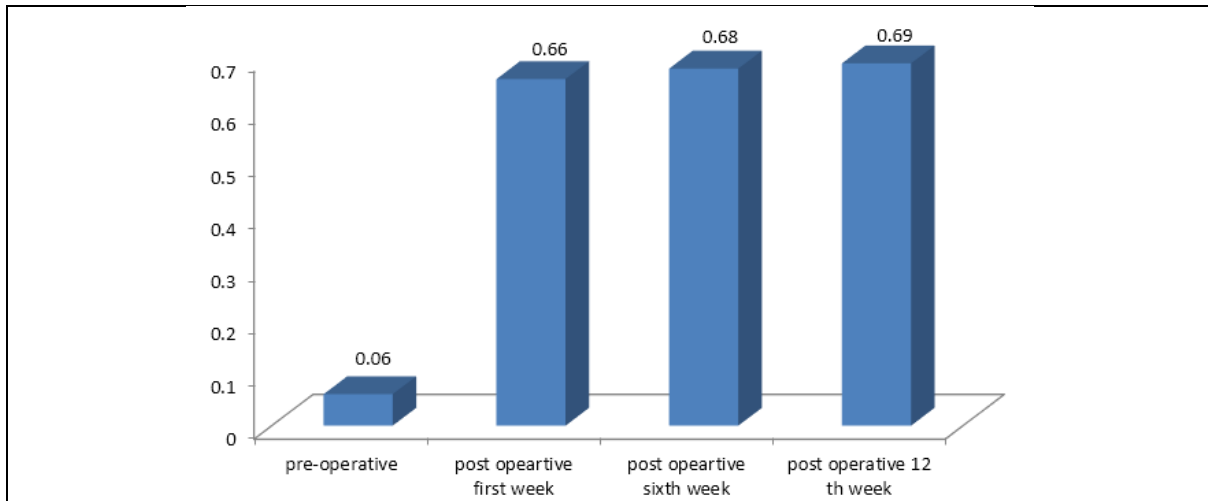


Figure 2: A comparison of visual acuity pre-operative and follow up

The pre-operative mean CME was found to be  $216.07 \pm 12.09$ , whereas the post-operative mean CME was found to be  $221.13 \pm 10.38$  at the first week,  $224.89 \pm 11.2$  at the sixth week,  $219.89 \pm 12.1$  at the 12th week follow-up as shown in Table 1, figure 3a, 3b, 3c and 3d.

Macular edema thickenss	Mean±SD
Pre operative	$216.07 \pm 12.09$
Post operative 1 <sup>st</sup> week	$221.13 \pm 10.38$
Post operative 6 <sup>th</sup> week	$224.89 \pm 11.2$
Post operative 12 <sup>th</sup> week	$219.89 \pm 12.1$

Table 1: Comparison of macular edema thickness preoperative and follow up

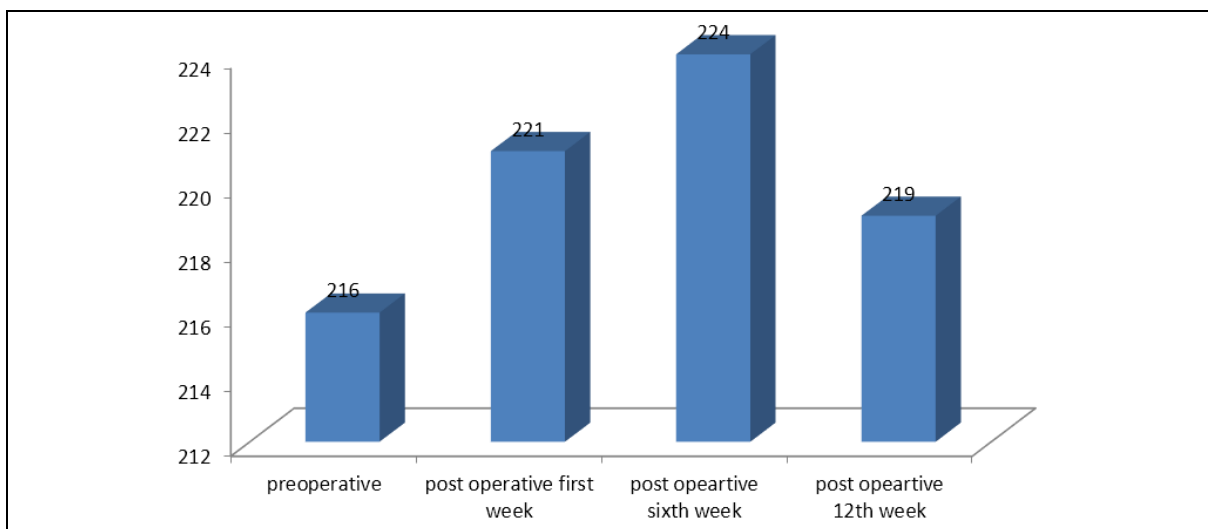


Figure 3a: Comparison of macular edema thickness preoperative and follow up

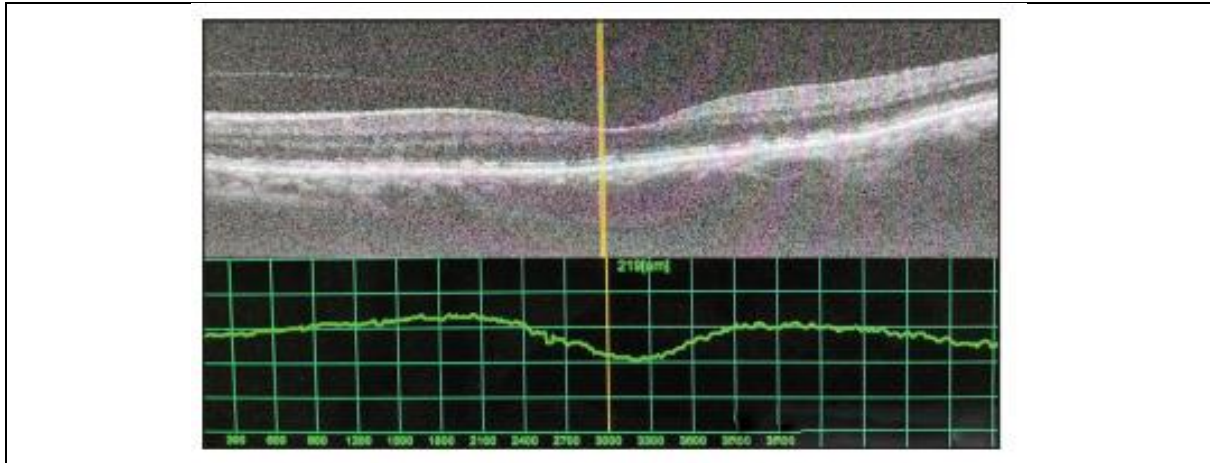


Figure 3b: Pre-operative central macular thickness

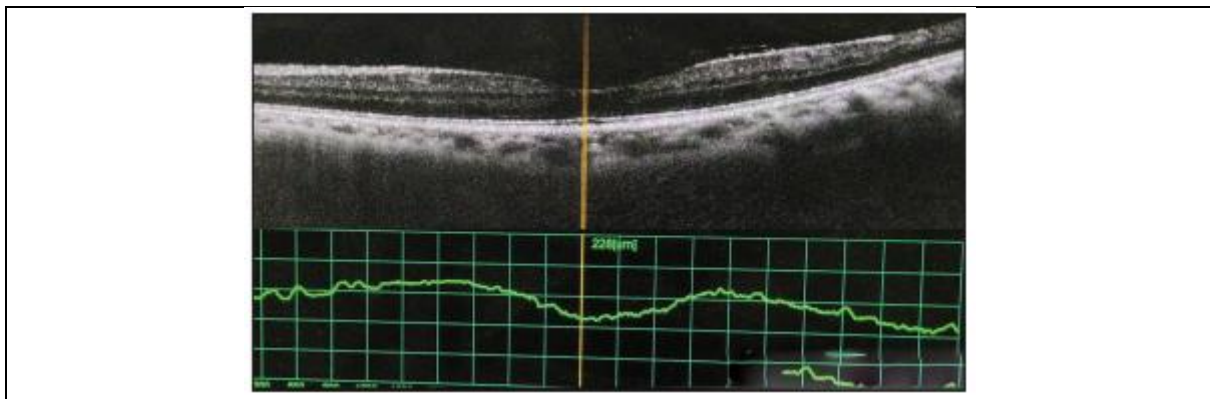


Figure 3c: Central macular thickness at 6 weeks post follow-up

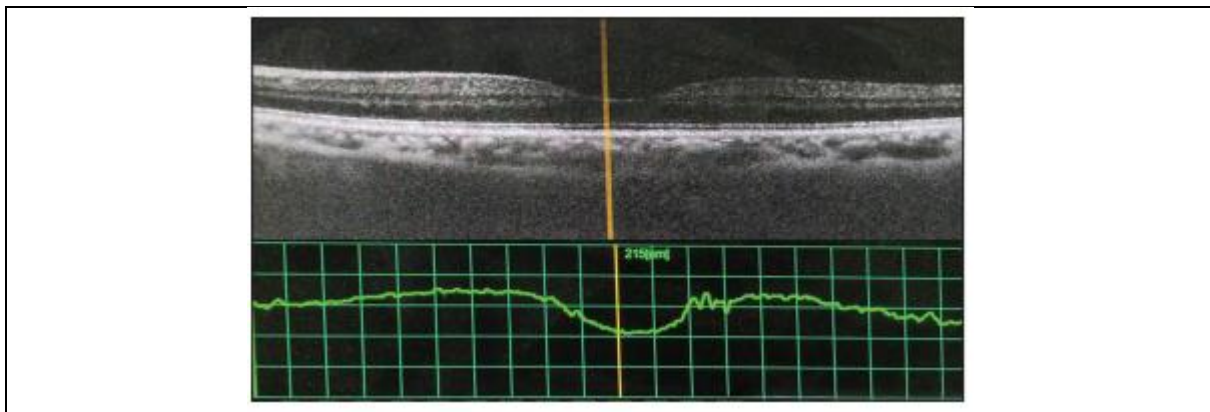


Figure 3d: Central macular thickness at 12 weeks post follow-up

The average thickness of the macular edema before surgery was compared to the average thickness after 1 week, 6 weeks, and 12 weeks after surgery using a paired t-test. The results showed a statistically significant P value ( $<0.001$ ). The highest level of macular edema was seen during the sixth week evaluation, while the lowest level was detected during the 12-week follow-up, as shown in Table 2.

Variable	Mean difference	SD	t value	P value
Preoperative-1-week post-operative CME	-5.06	1.71	18.786	$<0.001$

Preoperative-6-week post operative CME	-8.82	0.89	22.345	<0.001
Preoperative-12-week post operative CME	-3.82	0.01	15.673	<0.001

Table 2: Comparison between pre-operative & 1 week, 6 week, and 12 week post-operative macular thicknesses

#### 4. Discussion

After undergoing cataract surgery, there may be subtle changes in the thickness of the macula, which is the central part of the retina responsible for sharp vision. These changes can occur with or without any impact on visual acuity. Pseudophakic cystoid macular edema (PCME) is a recognised complication that can occur after cataract surgery. It is characterised by the leakage of fluid from the capillaries. While this phenomena typically resolves on its own, it can sometimes cause significant damage to central vision, which may persist or become permanent.[12] The present study was conducted among 100 subjects diagnosed of cataract who underwent surgery at a tertiary care hospital to assess the factors related to change in central macular thickness.

In our study the average age of the patients was  $60.45 \pm 21.03$  years. The female patient count (60) exceeded that of male patients (40). The average duration of the surgery was  $10.40 \pm 1.27$  minutes. Surgery was performed on the right eyes of 70 individuals, while the left eyes of 30 patients underwent surgery. The results were similar to study done by Vyas VJ et al.[12] and Bhargava S et al.[13] A different age distribution was noted with the study conducted by Salwan A et al.[14]

The pre-operative mean visual acuity was found to be  $0.06 \pm 0.03$ , whereas the post-operative mean BCVA was found to be  $0.66 \pm 0.15$  at the first week,  $0.68 \pm 0.18$  at the sixth week,  $0.69 \pm 0.16$  at the 12th week follow-up. The study undertaken by Nasreen et al [15], Jagow B et al [16], Cagini et al [17] and Sandeep K et al [18], and did not find any link between macular thickening and visual acuity.

The average central macular thickness (CME) in our study before surgery was measured to be  $216.07 \pm 12.09$ . After surgery, the average CME was determined to be  $221.13 \pm 10.38$  at the first week,  $224.89 \pm 11.2$  at the sixth week, and  $219.89 \pm 12.1$  at the 12th week follow-up. In their study, Bhargava et al. [13] found that the average macular thickness was  $235.43 \pm 14.87$   $\mu\text{m}$  one week after the operation,  $239.1 \pm 14.86$   $\mu\text{m}$  six weeks after the operation, and  $233.31 \pm 15.97$   $\mu\text{m}$  twelve weeks after the operation. These results were consistent with the findings of Salwan A et al. [14]. The disparities in macular thickness before and after surgery, as observed in the investigations conducted by Salwan A et al.[14] and Bhargava et al.[13], closely resembled our own findings.

This study has limitations due to small sample size and a key limitation being the absence of data on postoperative medicine usage. Many surgeons at various institutions have different approaches to the use of subconjunctival drugs during surgery and topical medications after surgery. Undoubtedly, these medications can affect the occurrence of postoperative cystoid macular edema (CME). However, several factors remained, including the age of the patient and the occurrence of cataract surgery after the operation. The main objective of this article was to determine any pre- or intra-operative factors that may increase the chance of developing cystoid macular edema (CME) after surgery.

In this study, we utilised OCT imaging for diagnosis of postoperative CME. However, it is important to note that this method may sometimes detect visually insignificant cases of CME. This is because some patients may not experience a loss in vision, and hence would not have been diagnosed with CME if not for the OCT imaging. Patients may also exhibit schisis

cavities on OCT without any leakage on FA, which might lead to an overestimation of the prevalence of CME. Alternatively, it may underestimate the occurrence of CME as eyes may show signs of angiographically significant CME on fluorescein angiography yet appear to be without fluid accumulation on OCT. There is no flawless methodology available to detect postoperative CME. However, the use of OCT is a reliable and noninvasive method for diagnosing fluid in the macula. We recognise that a significant number of eyes with postoperative cystoid macular edema (CME) may have gone undiagnosed because to the absence of symptoms.

The patient was omitted from this investigation due to the need for a post-operative OCT. In addition, a limited number of eyes underwent preoperative OCT. The data stored in the database suggests that there is a possibility that many individuals may have experienced preoperative macular edema. This condition could potentially affect the identified risk variables that are being examined to determine the likelihood of developing cystoid macular edema (CME) after repair. Another constraint of this study is the absence of a standardised assessment of refraction and visual acuity. The dataset does not provide information for analysing the timing of CME development and the corresponding visual acuities. In a study done by Iftikhar M et al it was found that 3.1 million of the about 7.3 million cataract procedures that were done in patients under the age of 18 between 2016 and 2019 that were registered in the IRIS Registry satisfied the study's eligibility requirements. Of those, 25 595 eyes (0.8%) out of 22112 patients had a diagnosis of CME. The average (standard deviation [SD]) duration between cataract surgery and CME diagnosis was 42 (22) days.[19]

The study's biggest strength lies in the utilisation of a comprehensive, multicentered clinical database. However, this approach does have limitations in terms of being unable to completely control individual surgeons and all surgical procedures. Nevertheless, it does enhance the generalizability of the data. Undoubtedly, further research is necessary to investigate the effectiveness of topical NSAIDs and steroids, as well as specific surgical techniques.

## 5. Conclusion

There is a strong link between the central macular thickness before and after surgery at 1 week, 6 weeks, and 12 weeks. An asymptomatic rise in macular thickness occurs following simple cataract surgery, reaching its highest point at 6 weeks after the procedure. By the 12th week after surgery, the macular thickness falls to a value close to normal. The OCT scan revealed an elevation in macular thickness while maintaining the structural integrity of the macula. No association was found between the best-corrected visual acuity (BCVA) and macular edema after the operation. Our study found a direct relationship between surgical duration and an increase in central macular thickness.

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