

Effect of Phacoemulsification Surgery on Central Macular Thickness

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Abstract

Objective: The objective of this study is to demonstrate the sustainability of changes in Central Macular thickness associated with Phacoemulsification surgery. **Materials & Methods:** Cohort study with 120 patient's eyes was conducted from March 2020 to August 2020 at Riphah International University Lahore. Sampling technique was non probability convenient sampling technique. Inclusion criteria include all patients willing to undergone phacoemulsification with intraocular lens implant (phaco) surgery and having cataract with controlled diabetes and hypertension. Exclusion criteria include all patients who didn't agree to undergone phaco surgery. Patients with any other ocular pathology were excluded from the study. Refractive status objectively assessed by Canon Autorefractor and Heine retinoscope. Vision was assessed at six (06) meters of distance using Snellen chart and recorded using Snellen notation. Average reading of both methods was taken. The phacoemulsification was done using "OertliCataRhex 3" and foldable lens was implanted during the surgery. For the measurement of the macular thickness Zeiss Cirrus HD-OCT 500 model was used. All data entered and analyzed by SPSS 20 (Statistical Package for Social Sciences). Normality of quantitative data was checked by Shapiro Wilk test. Wilcoxon sign test was used for non-parametric data. P value <0.05 was taken as significant. **Results:** This study include 120 patient's eyes that undergone successful phacoemulsification surgery. Macular thickness before the surgery was assessed and recorded on proforma. Mean macular thickness before surgery was 210 μm . After the surgery the macular thickness was recorded after 01 week and 04 weeks and the mean values were 243 μm and 207 μm respectively. The best corrected visual acuity after the surgery was 6/6 in 21%, 6/9 in 47% and 6/12 in 31% patients. There is significant difference between the macular thickness of before and after the phacosurgery ($p=0.00$). The macular thickness was decreases with the time and settled after 04 weeks of surgery. **Conclusion:** There is significant difference between the macular thickness before and after phaco surgery ($p=0.000$). The macular thickness is slightly raised after the surgery and observed to lower down after 04 week of surgery.

Keywords: Phaco; Phacoemulsification; Cataract; OCT; Zeiss; Macula; Macular thickness

Introduction

The objective of this study is to demonstrate the sustainability of changes in Central Macular thickness associated with Phacoemulsification surgery. This study gave the comparison of macular thickness before and after phacoemulsification. ^[1]

Phacoemulsification (phaco) has become the preferred form of cataract removal. Advantages of phacoemulsification are that only a small incision into the cornea or sclera of an eye is needed to remove the opaque lens. Moreover, the breakdown of the cataractous lens can be done very swiftly. After the cataract is removed, an IOL is inserted to replace the original lens. The phaco technique uses a hand-held microsurgical tool which is known as phacoemulsifier. ^[2] This phacoemulsifier consist of a

handpiece and a minor width needle with a tip to be incorporated into the tiny incision of the eye. The needle and hence the tip are pulsated by an ultrasonic supplier. It breaks the cataract into small fragments which are sucked out through the same tip in a controlled manner. The tip is hence constructed for emulsifying, fragmenting and also comprises a central hollow bore or lumen for the suction or aspiration of the fragments. ^[3]

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It was seen that during phaco surgery small amount of section/emulsifier effect is seen on retina especially Macula. Eventually unsuccessful cataract surgical procedure causes minimal intraoperative trauma, which results in the thickening of macula. [4]

Cataract is defined as the clouding in the eyes or loss of transparency of the lens resulting in the breakdown of tissue and protein plodding. The causes of cataract development in the eyes are numerous including hypertension, diabetes, systematic medication like cortisone, trauma and other pathologies. [5]

For posterior segment evaluation, Optical Coherence Tomography (OCT) is used to analyze the thickening of retina especially macula. OCT is a method used for macular thickness measurement and quantitative assessment of the retina. [6] OCT is a reproducible, non-invasive and non-contact system of imaging providing higher resolution cross sectional pictures of the posterior section. Imaging of the anterior segment has also been increasingly adopted. OCT utilizes near infrared light rays for interferometry for the formation of image of retina layer by using Michelson interferometry principle. The basic principle of OCT (Michelson Interferometry) is to measure the time-of-flight of light echoes from tissue, which is done by creating an interference pattern between light transmitting in one arm and light transmitting in the reference arm of a Michelson interferometer. [7]

In recent years it has become increasingly common to use OCT) to study the macular region. There are a lot of techniques to assess macula and measure macular thickness. But OCT is one of the best techniques, which is easy to use, non-invasive, give qualitative & quantitative data and easily reproducible. [8-10] This technique has the advantage of being simple to perform, non-invasive, and extremely sensitive, as it can provide measurements of the macular region with a resolution of 8 μm -10 μm (micron meter). Moreover, OCT has been used to study the macular region after uncomplicated cataract surgery. [11]

The Macula is a rounded area of retina at the posterior pole of eye, lying within the temporal vascular arcades. It measures between 5 mm and 6 mm in diameter, and sub serves the central 15°-20° of the visual field. Histologically, it shows more than 1 layer of ganglionic cells, in contrast to the single ganglion cell layer of the peripheral retina. Lutein, xanthin and zeaxanthin which are yellow xanthophyll carotenoid pigments found in the inner layers of macula in much higher concentration than the peripheral retina. Hence the full name Macula Lutea. [12]

Macular thickness and the macular region change correlate with the changes of visual function. In macular edema the thickness of retinal layers is increased retinal thickness and often leads to vision loss. Macular edema is an intra-retinal fluid accumulation in the central retina. The blood-retinal barrier is responsible for the integrity of the macula. Tight junctions between cells of intra-retinal capillaries and pigmented epithelium cells prevent the progress of fluid accumulation within the macula. Macular edema after cataract surgery occurs in a clinical and sub-clinical form. [13-16]

Materials and Methods

Cohort study with 120 patient's eyes was conducted from March

2020 to August 2020 at Riphah International University Lahore. Sampling technique was non probability convenient sampling technique. Inclusion criteria include all patients willing to undergone phacoemulsification with intraocular lens implant (phaco) surgery and having cataract with controlled diabetes and hypertension. Exclusion criteria include all patients who didn't agree to undergone phaco surgery. Patients with any other ocular pathology were excluded from the study. Patients with uncontrolled hypertension and diabetics were unrolled in the study. Refractive status objectively assessed by Canon Autorefractor and Heine retinoscope. Vision was assessed at six (06) meters of distance using Snellen chart and recorded using Snellen notation. Average reading of both methods was taken. The phacoemulsification was done using "OertliCataRhex 3" and foldable lens was implanted during the surgery. For the measurement of the macular thickness Zeiss Cirrus HD-OCT 500 model was used. Approval from the ethical review committee of Riphah International University Lahore campus. All data were entered and analyzed by SPSS 20.0 (Statistical Package for Social Sciences). Normality of quantitative data was checked by Shapiro Wilk test. Wilcoxon sign test was used for non-parametric data. P value<0.05 was taken as significant.

Results

120 patient's eyes that undergone successful phacoemulsification surgery was enrolled in this study. Macular thickness before and after the surgery was assessed and recorded on proforma. Mean macular thickness before surgery was 210 μm . After the surgery the macular thickness was recorded after 01 week and 04 weeks and the mean values were 243 μm and 207 μm respectively.

The clinical characteristics are listed in Table 1 and Table 2. The frequency data of best corrected visual acuity before the phaco surgery showed that the vision of patients was 6/18 in 5%, 6/24 in 40.83%, 6/36 in 38.33% and 6/60 in 15.83% of patients respectively [Figure 1]. The frequency data of best corrected visual acuity after the phaco surgery showed that the vision of patients was 6/6 in 21%, 6/9 in 47% and 6/12 in 31% patients [Figure 2].

Descriptive statistics of macular thickness before and after the phaco surgery was presented in Table 1. Mean macular thickness before the phaco surgery was 210 with std. error of mean 0.52. Mean macular thickness after phaco surgery at 01 week was 243.99 with std. error of mean 0.83. Mean macular thickness after phaco surgery at 04 week was 207.66 with std. error of mean 0.65. There is significant difference between the macular thickness of before and after the phaco surgery ($p=0.00$). The macular thickness was decreases with the time and settled after 04 weeks of surgery [Table 3].

Discussion

In this study recent include 120 patient's eyes that undergone successful phacoemulsification surgery. Macular thickness before the surgery was assessed and recorded on proforma. Mean macular thickness before surgery was 210 μm . After the surgery the macular thickness was recorded after 01 week and 04 weeks and the mean values were 243 μm and 207 μm respectively. The best corrected visual acuity after the surgery was 6/6 in 21%, 6/9

Table 1: Descriptive statics of macular thickness before and after the phaco surgery.

	Descriptive statistics											
	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness	Kurtosis	Std. Error	Statistic	Std. Error
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
Age	120	15	40	55	46.94	0.26	2.8	7.8	0.07	0.22	0.8	0.4
Macular Thickness Before Phaco	120	39	188	227	210.58	0.52	5.7	32.8	-1.41	0.22	4.2	0.4
Macular Thickness After Phacoat 01_Week	120	50	220	270	243.99	0.83	9.1	83.5	0.3	0.22	-0.1	0.4
Macular Thickness After Phacoat 04_Week	120	39	188	227	207.66	0.65	7.1	50.9	-0.61	0.22	1.3	0.4

*Mean macular thickness before the phaco surgery was 210 with std. error of mean 0.52. *Mean macular thickness after phaco surgery at 01 week was 243.99 with std. error of mean 0.83. *Mean macular thickness after phaco surgery at 04 week was 207.66 with std. error of mean 0.65.

Table 2: Test of normality was applied and the data was non parametric.

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Age	0.142	120	0	0.965	120	0.003
Macular Thickness Before Phaco	0.158	120	0	0.878	120	0
Macular Thickness After Phacoat 01_Week	0.152	120	0	0.951	120	0
Macular Thickness After Phacoat 04_Week	0.222	120	0	0.91	120	0

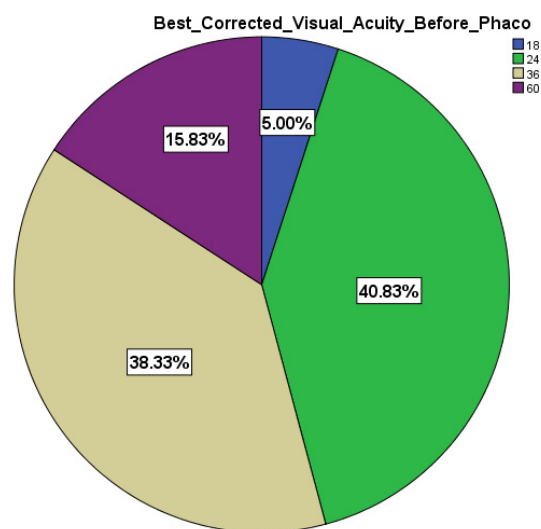


Figure 1: Shows that the best corrected visual acuity before the phaco surgery was 6/18 in 5%, 6/24 in 40.83%, 6/36 in 38.33% and 6/60 in 15.83% of patients respectively.

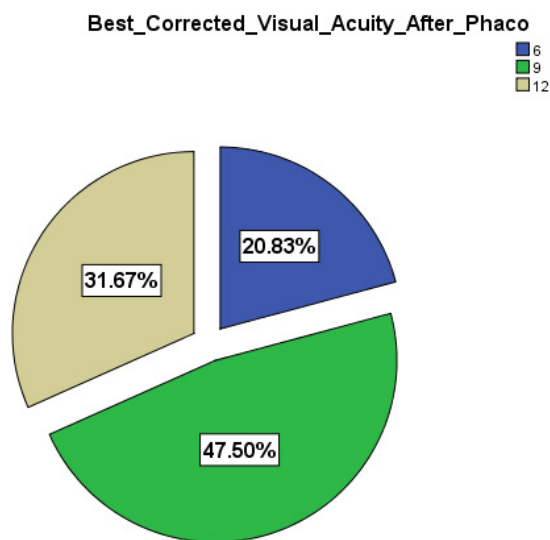


Figure 2: Shows that the best corrected visual acuity after the phaco surgery was 6/6 in 20.83%, 6/9 in 47.53%, 6/12 in 31.67% of patients respectively.

Table 3: Two sample related non parametric test was applied and showed significant difference between the before and after the phaco surgery macular thickness.

Null hypothesis	Test	Sig.	Decision
The median of difference between macular thickness before phaco and macular thickness after phaco	Related sample Wilcoxon-Signed Rank Test	0	Reject the Null Hypothesis

in 47% and 6/12 in 31% patients. There is significant difference between the macular thickness of before and after the phaco surgery (p=0.00). The macular thickness was decreases with the time and settled after 04 weeks of surgery.

In this study the range of age of patients that undergone phacoemulsification surgery was between 40 years-55 years. The mean macular thickness before the surgery was 210.58 μ m

$\pm 0.52 \mu$ m the mean macular thickness after the surgery at first week was 243.99 μ m $\pm 0.83 \mu$ m. The mean macular thickness before the surgery at 4th week was 207.66 μ m $\pm 0.65 \mu$ m. The maximum macular thickness that observed at 1st week of surgery was 270 μ m. The minimum macular thickness that observed at 1st week of surgery was 220 μ m. The minimum and maximum macular thickness that observed at 4th week of surgery was 188

µm and 227 µm respectively.

A study was conducted by Irfanperente et al. showed that the mean central macular thickness was before surgery 202.4 µm ± 25.9 µm and after the surgery 200.4 µm ± 26.1 µm. The macular thickness at first week of surgery (p=0.29), 208.4 µm ± 27.6 µm and at 4th week of surgery 213.5 µm ± 29.4 µm (p<0.001). The results of this study showed the same statistics. [17-20]

A lot of studies, which showed the correlation between the progression of macular thickness and cataract surgery was done and one from it which is conducted by the Brahm et al. showed that The mean macular thickness before, phaco at postoperative week 1, and at post-operative week 4 was 257.03 µm, 262.82 µm, and 265.15 µm respectively. This study results also support these statistics. [21-23]

Another study which was conducted by the Decroos showed that the pre and post-operative macular thickness was statically significant (p=0.0001). This study also showed the same results. [24,25]

Conclusion

There is significant difference between the macular thickness before and after phaco surgery (p=0.000). The macular thickness is slightly raised after the surgery and observed to lower down after 04 week of surgery.

Recommendation

The possible onset of macular alterations after phaco surgery must be taken into account as a potential later complication, because it can lead to a permanent loss of visual acuity. Longer follow-up of patients is required for the macular consequences, and different treatment protocols should be studied in a randomized controlled fashion. The results suggest that long-term follow-up of more than 4-week is needed to see whether CMT changes return to preoperative levels.

Reference

- DeCroos FC, Afshari NA. Perioperative antibiotics and anti-inflammatory agents in cataract surgery. *Curr Opin Ophthalmol.* 2018;19:22-26.
- Panchapakesan J, Rochtchina E, Mitchell P. Five-year change in visual acuity following cataract surgery in an older community: The blue mountains eye study. *Eye.* 2014;18:278-282.
- Linebarger EJ, Hardten DR, Shah GK, Lindstrom RL. Phacoemulsification and modern cataract surgery. *Surv Ophthalmol.* 2019;44:123-147.
- Brien TP. Emerging guidelines for use of NSAID therapy to optimize cataract surgery patient care. *Curr Med Res Opin.* 2015;21:1131-37.
- Nelson ML, Martidis A. Managing cystoid macular edema after cataract surgery. *Curr Opin Ophthalmol.* 2013;14:39-43.
- GASS JD. Cystoid macular edema and papilledema following cataract extraction. *JAMA Ophthalmol.* 2016;76:646-650.
- Ursell PG, Spalton DJ, Whitcup SM, Nussenblatt RB. Cystoid macular edema after phacoemulsification: Relationship to blood-aqueous barrier damage and visual acuity. *J Cataract Refract Surg.* 2019;25:1492-1497.
- Flach AJ. The incidence, pathogenesis and treatment of cystoids macular edema following cataract surgery. *Trans Am Ophthalmol Soc.* 2018;96:557-634.
- Rho DS. Treatment of acute pseudophakic cystoid macular edema: Diclofenac versus ketorolac. *J Cataract Refract Surg.* 2013;29:2378-2384.
- Kim SJ, Equi R, Bressler NM. Analysis of macular edema after cataract surgery in patients with diabetes using optical coherence tomography. *Ophthalmol.* 2017;114:881-889.
- Dowler JGF, Sehmi KS, Hykin PG, Hamilton AMP. The natural history of macular edema after cataract surgery in diabetes. *Ophthalmol.* 2014;106:663-668.
- Lara-Smalling A, Egilmez CT. Diabetes and cataract surgery: Preoperative risk factors and positive nursing interventions. *Insight (American Society of Ophthalmic Registered Nurses)* 2014;39:18-20.
- Biro Z, Balla Z, Kovacs B. Change of foveal and perifoveal thickness measured by OCT after phacoemulsification and IOL implantation. *Eye.* 2018;22:8-12.
- Beebe DC, Shui YB, Siegfried CJ, Holekamp NM, Bai F. Preserve the (intraocular) environment: The importance of maintaining normal oxygen gradients in the eye. *Jpn J Ophthalmol.* 2014;58:225-231.
- Chu CJ, Johnston RL, Buscombe C, Sallam AB, Mohamed Q, Yang YC. Risk factors and incidence of macular edema after cataract surgery. A database Study of 81984 eyes. *Ophthalmol.* 2015;45:34-40.
- Liu J, Jones RE, Zhao J, Zhang J, Zhang F. Influence of uncomplicated phacoemulsification on central macular thickness in diabetic patients: A meta-analysis. *PLoS ONE.* 2015;10:90-95.
- Chung J, Kim MY, Kim HS, Yoo JS, Lee YC. Effect of cataract surgery on the progression of diabetic retinopathy. *J Cataract Refract Surg.* 2012;28:626-630.
- Henricsson M, Heijl A, Janzon L. Diabetic retinopathy before and after cataract surgery. *Br J Ophthalmol.* 2016;80:789-793.
- Kusbeci T, Eryigit L, Yavas G, Inan UU. Evaluation of cystoid macular edema using optical coherence tomography and fundus fluorescein angiography after uncomplicated phacoemulsification surgery. *Curr Eye Res.* 2012;37:327-333.
- Romero-Aroca P. Targeting the pathophysiology of diabetic macular edema. *Diabetes Care.* 2010;33:2484-2485.
- Chae JB, Joe SG, Yang SJ, Lee JY, Sung KR, Kim JY, et al. Effect of combined cataract surgery and ranibizumab injection in postoperative macular edema in non-proliferative diabetic retinopathy. *Retina.* 2014;34:149-156.
- Sahin M, Cingü AK, Gözümlü N. Evaluation of cystoid macular edema using optical coherence tomography and fundus autofluorescence after uncomplicated phacoemulsification surgery. *J Ophthalmol.* 2013;13:37-45.
- Hartnett ME, Tinkham N, Paynter L, Geisen P, Rosenberg P, Koch G, et al. Aqueous vascular endothelial growth factor as a predictor of macular thickening following cataract surgery in patients with diabetes mellitus. *Am J Ophthalmol.* 2016;148:895-901.
- Mittra RA, Borrillo JL, Dev S, Mieler WF, Koenig SB. Retinopathy progression and visual outcomes after phacoemulsification in patients with diabetes mellitus. *Arch Ophthalmol.* 2010;118:912-917.
- Liao SB, Ku WC. Progression of diabetic retinopathy after phacoemulsification in diabetic patients: A three-year analysis. *Chang Gung Med J.* 2013;26:829-834.