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Post-Operative Changes in Keratometry, Corneal Endothelial Cell Count and Central Corneal Thickness after Phacoemulsification with Different Number of Side Port Incisions: A Prospective Interventional Study

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ABSTRACT

Cataract surgery is the commonest surgery performed by Ophthalmologists and phacoemulsification is considered the best technique for the same. Our aim is to see the post-operative changes in keratometry, corneal endothelial cell count and central corneal thickness after phacoemulsification with different number of side port incisions. Patients undergoing cataract surgery were divided into two groups A and B. Preoperative keratometry, corneal endothelial cell count and central corneal thickness was recorded in all cases. Group A included patients undergoing Phacoemulsification with a 2.8 mm main clear corneal incision and two standard side port incisions of 1mm each with a 15° side port knife. Group B included patients undergoing Phacoemulsification with a 2.8 mm main clear corneal incision and one side port incision of 1 mm with a 15° side port knife. Pre-and post-operative parameters in both the groups regarding the keratometry difference were comparable and clinically significant probability values were obtained in all follow-ups. The average keratometry difference in both the groups pre-operatively was more than 0.80. Post-operatively there was a decrease in keratometry difference in both groups which were comparable. The difference was statistically significant at POD-30due to pre-operative values being statistically significant ($p<0.05$). Our study concluded that the number of side-port incisions did not play a significant role in final ECC, CCT and Keratometry values post-operatively. The BCVA was almost similar in the two groups with no role of number side-port incision.

INTRODUCTION

Cataract, or opacification of the lens, is the most common cause of visual impairment worldwide and poses one of the greatest public health challenges of the 21st century. The World Health Organization (WHO) conducted a global review of surveys in 2004 that demonstrated that age-related cataract remained the leading cause of blindness globally, accounting for 48% of world blindness[1]

Cataract surgery is the commonest surgery performed by Ophthalmologists and phacoemulsification is considered the best technique for the same. The advantages of phacoemulsification over other surgeries are that the recovery of vision is better and healing is faster.

As more patients expect excellent visual acuity, today's cataract surgery is both a therapeutic and refractive procedure and surgically-induced astigmatism (SIA) is still a common obstacle for achieving excellent uncorrected visual acuity. Previous literature has shown that SIA is related to incision length, incision location, incision architecture and suture closure technique[2] Small sized incisions give a rapid and a stable optical recovery and thus lesser SIA. any studies were done to compare the astigmatism with different types of small incisions in different locations as well like superior, superonasal, superotemporal and temporal[3]. Thus, smaller side-port incision size and lesser number of incisions are expected to lower surgically induced astigmatism (SIA) and allow more rapid visual rehabilitation postoperatively.

Corneal endothelial cells are non-replicative and the loss of these cells is only compensated for by the migration, enlargement and increasing heterogeneity of the remnant cells[4]. Loss of endothelial pump function can lead to increased corneal thickness and decreased corneal transparency referred to as corneal decompensation[5]. Corneal decompensation is a rare but potentially vision-threatening complication after phacoemulsification surgery. Previous studies have shown that intraocular surgeries like cataract extraction affect corneal endothelial density. After endothelial damage surrounding cells are not capable of regeneration leading to a fall in cell density, which if less than critical level (500 cells/mm^2) results in corneal decompensation with corneal oedema and loss of transparency affecting the final post-operative visual outcome significantly. Thus, the evaluation of risk factors for preoperative, intraoperative and postoperative endothelial cell loss provides important information for the surgeon.

Variable endothelial cell loss has been observed during phacoemulsification surgery depending on the technique used such as the number, size and location of incisions, instrumentation, use of protective viscoelastic material and the irrigating solution used[6]. Although, a number of studies have been done to assess the endothelial damage either by cell counts or indirectly by measuring corneal thickness postoperatively but not very many studies have been conducted previously to study the role of number of side-port incisions and their effect on endothelial cell count and central corneal thickness changes.

This study, therefore, aims to determine changes in keratometric findings, increase in central corneal thickness (CCT) and to assess the length of time it takes for the cornea to return to its preoperative thickness value in patients after phacoemulsification surgery at Integral University, a tertiary centre of North India.

MATERIALS AND METHODS

This prospective randomized interventional study was conducted in Dept. of Ophthalmology and Department of Medicine, Integral Institute of Medical Sciences and Research, Integral University, Lucknow, U.P., India which included 224 patients who underwent phacoemulsification for senile cataract over a period of 18 months (February 2021 to July 2022). Inclusion Exclusion criteria included patients complicated, traumatic or congenital cataracts, patients with history of eventful surgery in the other eye or history of ocular or surgical history in the same eye, corneal pathologies, deranged metabolic profile or those not giving consent. Approval from Institutional research and Ethical Committee was taken before the start of the study. An informed verbal, as well as written consent was taken from the patient as well as attendant, if present.

Patients diagnosed with cataract in lens underwent complete ophthalmologic evaluation including best corrected visual acuity, IOP and slit lamp examination to determine the type and stage of senile cortical cataract and nuclear grading for hardness of cataract. Based on the above parameters, patients were selected for phacoemulsification surgery.

Patients undergoing cataract surgery were divided into two groups A and B. Preoperative keratometry, corneal endothelial cell count and central corneal thickness was recorded in all cases. Group A included patients undergoing Phacoemulsification with a 2.8 mm main clear corneal incision and two standard side port incisions of 1mm each with a 15° side port knife. Group B included patients undergoing Phacoemulsification with a 2.8 mm main clear corneal incision and one side port incision of 1 mm with a 15° side port knife. Follow up post-op visit advised at 1 week, at 4 weeks and at 3 months interval to assess keratometry, endothelial cell count and central corneal thickness.

RESULTS

Central corneal thickness-pre and post-operative comparison between the two groups: Pre and post-operative parameters in both the groups regarding the CCT were comparable and clinically significant probability values were obtained in follow-ups on Day 7 and Day 30 but by Day 90, corneal thickness has come nearby to it's pre-operative value with insignificant difference between Group A and B (Fig. 1).

Average endothelial cell count: Pre and post-operative comparison between the two groups: Pre and post-operative parameters in both the groups regarding the ECC were comparable and clinically insignificant probability values were obtained in all follow-ups. The average endothelial cell count in both the groups pre-operatively was more than 2500. Post-operatively there was a marginal fall in endothelial cells in both the groups which was comparable (Fig 2).

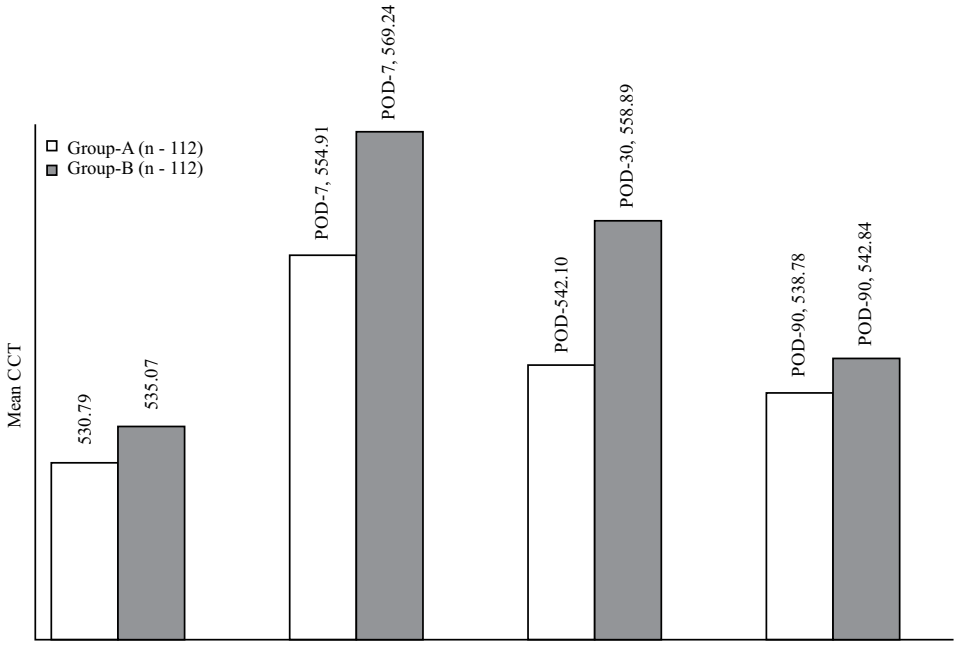

Fig. 1: Central corneal thickness-pre and post-operative comparison between the two groups
POD-7: Post-operative day 7, POD-30: Post-operative day 30 and POD-90: Post-operative day 90

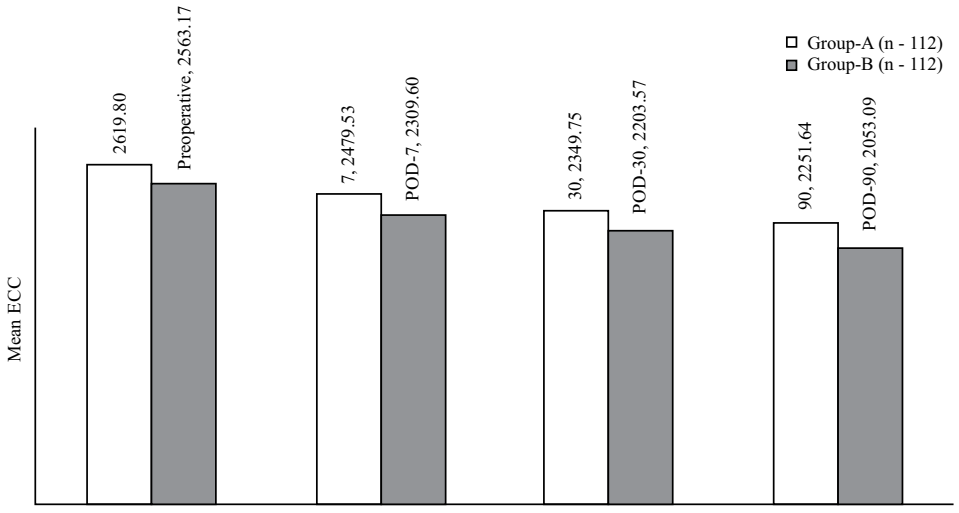

Fig. 2: Average endothelial cell count-pre and post-operative comparison between the two groups
POD-7: Post-operative day 7, POD-30: Post-operative day 30 and POD-90: Post-operative day 90

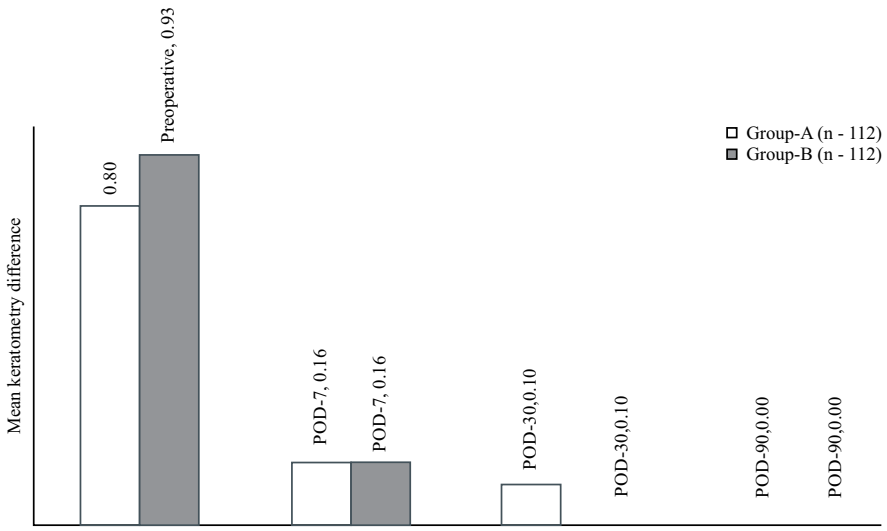

Fig. 3: Average keratometry difference Pre And Post-operative comparison between the two groups
POD-7: post-operative day 7, POD-30: Post-operative day 30 and POD-90: post-operative day 90

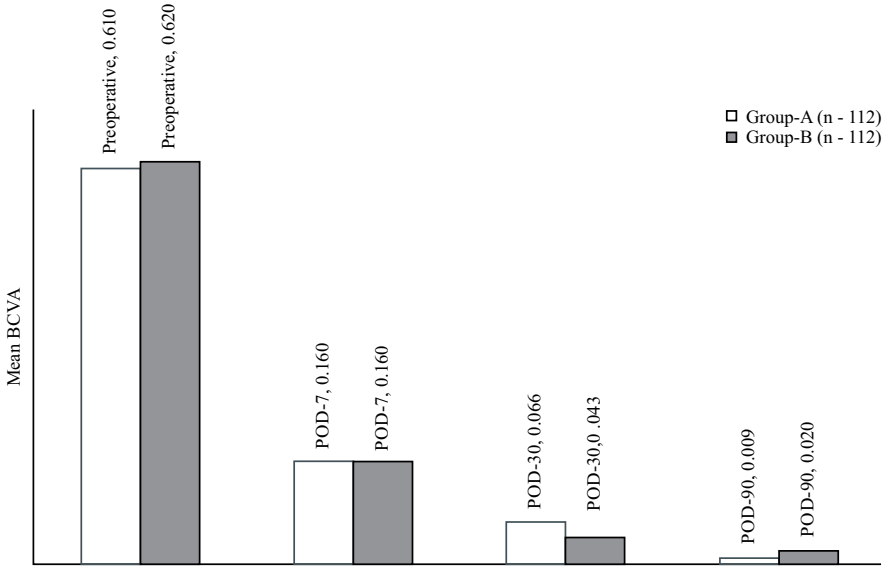

Fig. 4: BCVA-pre and post-operative comparison between the two groups
POD-7: Post-operative day 7; POD-30: Post-operative day 30 and POD-90: Post-operative day 90

Comparison of pre-operative and post-operative keratometry difference on POD-7, POD-30, POD-90: Pre-and post-operative parameters in both the groups regarding the keratometry difference were comparable and clinically significant probability values were obtained in all follow-ups. The average keratometry difference in both the groups pre-operatively was more than 0.80. Post-operatively there was a decrease in keratometry difference in both groups which were comparable. The difference was statistically significant at POD-30 due to pre-operative values being statistically significant ($p<0.05$) (Fig. 3).

BCVA-pre and post-operative comparison between the two groups: Pre and post-operative BCVA parameters in both the groups regarding the vision were comparable and no clinically significant probability values were obtained in any of the follow-ups (Fig. 4).

DISCUSSIONS

Cataract is one of the most common cause of visual impairment all over the world. It's mainstay of treatment is surgical with phacoemulsification being the most advanced technique being practiced worldwide as well as in India. This surgical technique has emerged in a big way as it is very quick and has an excellent refractive outcome. The refractive outcome is dependent on various factors including surgically induced astigmatism, change in central corneal thickness and endothelial cell loss post surgery. These can vary depending on the number of incisions. Therefore, this study was conducted to compare the effect of one side-port incision versus two side-port incisions based on the aforementioned parameters.

The pre-operative central corneal thickness in the two groups was slightly less than the average corneal thickness of 540 micron of an adult. In Group A, it was 530.79±39.64 microns whereas, in Group B, it was 535.07±34.54 microns. Maximum number of patients in both the groups had CCT< = 519 µm whereas minimum number of patients had CCT >541 µm.

These observations were in concurrence with a study by Ganekal and Nagarajappa[7], that showed thinning of cornea at a rate of 3-7 µm has been observed in older age group of some ethnic groups. Another study by Foster PJ et al with 1242 participants, aged 10-87 years showed similar results with CCT decreasing by 5-6 µm for each decade of life.

The average CCT of Group A and Group B was comparable preoperatively (Group A530.79±39.64 µm and Group B-535.07±34.54 µm) but clinically significant difference was noted on postoperative day 7 (Group A-554.91±34.37 µm and Group B-569.24±35.75 µm) and post-operative day 30 (Group A-542.10±31.30 µm and Group B-558.89±33.34 µm) between the two groups. However by day 90, the corneal thickness nearly returned to the pre-operative value with clinically insignificant difference between both the groups.

There is a significant increase in the CCT when analysing pre- and post-cataract surgery CCT, with a maximum increase in CCT on post-op day 7. The CCT shows decreasing trend over days 30 and 90. The difference between the pre-operative value of CCT and final average CCT recorded on Day 90 is clinically insignificant.

A study by Lundberg *et al*.[8] showed similar results with a return of CCT to normal thickness one month post-operatively after phacoemulsification.

Endothelial alteration is considered an important parameter of surgical trauma and essential for estimating the safety of the surgical technique. After cataract surgery, endothelial cell density decreases at a greater rate than in healthy, unoperated corneas. Similar results were shown in a study by Suzuki *et al*.[9] reported that endothelial loss varies between 4 and 25% and the period of increased postoperative endothelial cell loss remains unknown. Endothelial cell loss begins soon after surgery, continues for at least 10 years postoperatively and may continue throughout the patient's life.

A study by Theodoulidou *et al*.[10] comparing phacoemulsification and conventional ECCE reported a 10% reduction in endothelial cells in both groups.

In a study by Rosner[11] comparing endothelial cell loss after conventional ECCE, MSICS and phacoemulsification, the ECC decreased by 4.72, 4.21 and 5.41%, respectively, with no significant difference between the three groups. The occurrence of posterior capsular rupture and vitreous loss at surgery leads to a statistically significantly higher endothelial cell loss (18.9% vs. 11.5%, p = 0.003).

In our study, pre and post-operative parameters in both the groups regarding the endothelial cell count (ECC) were having clinically insignificant values in all follow-ups. The average endothelial cell count in both the groups pre-operatively was more than 2500. Post-operatively there was a marginal fall in endothelial cells in both the groups which was comparable.

A study by Beltrame from Italy, compared endothelial cell damage between scleral tunnel incisions and clear corneal tunnel. It concluded that scleral tunnel led to less postoperative endothelial cell damage than clear corneal tunnel. Because MSICS was performed through the scleral tunnel incision, it may have caused less endothelial cell loss than phacoemulsification performed through a clear corneal tunnel incision. This is contrary to our study in which mean endothelial cell loss was 368 in Group A with two side-port incisions compared to 510 in group B with single side-port incision.

Thus, in group A, on comparison of preoperative and post-operative day 90 mean ECC was 2619.79±285.39 and 2251.64±233.17, respectively. In group B, preoperative and post-op day 90 mean ECC was 2563.16±406.06 and 2053.09±327.24, respectively. There was a clinically significant difference observed in both groups preoperatively and postoperatively ($p<0.05$).

In our study, in group A preoperative and postoperative (day 90) mean difference in axis's was 0.80±0.38 and 0.90±0.57, respectively whereas in group B preoperative and postoperative (day 90) mean difference in axis's was 0.93±0.40 and 1.03±1.00, respectively. There was a clinically non-significant difference observed in both groups preoperatively and postoperatively ($p>0.05$).

Preoperatively, maximum number of patients in group A had difference in keratometry axis's between 0.6-1.0 whereas, minimum number of patients had difference in keratometry axis's <=0.24.

Postoperatively, maximum number of patients in group A had difference in keratometry axis's between 0.25-0.5.

Preoperatively, maximum number of patients in group B had difference in keratometry axis's between 0.6-1.0 whereas minimum number of patients had difference in keratometry axis's <=0.24. Postoperatively, maximum number of patients in group B had difference in keratometry axis's between 0.25-0.5.

There was a clinically non-significant difference observed in both groups preoperatively and postoperatively ($p>0.05$).

CONCLUSION AND LIMITATIONS

In the present scenario, the most advanced and preferred modality of treatment for cataract is phacoemulsification with the advantage of better healing and faster recovery, specially in tertiary healthcare centers. With such advancements in the field of cataract surgeries, phacoemulsification has become both therapeautic and refractive procedure. Central corneal thickness change, endothelial cell loss and surgically induced astigmatism are important factors for predicting the refractive outcome. Thus, this study was conducted to evaluate the changes in these parameters with variable number of side-port incisions. Our study concluded that the number of side-port incisions did not play a significant role in final ECC, CCT and Keratometry values post-operatively. The BCVA was almost similar in the two groups with no role of number side-port incision. Thus, the number of side-port incisions does not play a significant role in predicting final visual outcome and it can be left to the surgeon's preference. True randomization was not possible because the choice of surgery and intraocular lens is largely governed by the socioeconomic status of the patient. A more intensive, randomized study with larger sample size is required which will help us come to a more precise conclusion.

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