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COMPARISON OF ENDOTHELIAL CELL LOSS AND CORNEAL THICKNESS CHANGES FOLLOWING MANUAL SMALL INCISION CATARACT SURGERY (MSICS) AND PHACOEMULSIFICATION

Ophthalomology

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ABSTRACT

A comparative analysis of endothelial cell loss was done after manual small incision cataract surgery and phacoemulsification with 100 patients in each group in a tertiary care eye hospital in India. Follow up was done at 3rd and 6th week post op for mean endothelial cell density, central corneal thickness. Analysis was done on NIDEK CEM-530 Specular microscope. Males and females were equally distributed mainly in 40-75 years of age group. The visual acuity in group A (phacoemulsification) was 6/6 in 50% patients while in group B it was 6/6 in 55% patients. There was more decrease in mean endothelial cell density in group (phacoemulsification) 4.24% vs 3.87%. Corneal edema occurred in both the groups initially but was not statistically significant. All through in our study, there was more corneal edema, endothelial cell loss and decrease in hexagonality in phacoemulsification group. However, the difference was not statistically significant. Hence, both the surgeries are relatively safe pertaining to corneal endothelial health keeping in mind the skill of operating surgeon and technique used.

KEYWORDS

Manual small incision cataract surgery (MSICS), Phacoemulsification, Central corneal thickness, Cell density, Specular Microscope.

INTRODUCTION

According to vision 2020,Globally, 285 million people are visually impaired. Of which, 39 million people are blind in the world. Of approximately 5 million blind in India 80% is avoidable.The leading cause of avoidable blindness is cataract.According to Vision 2020: the Right to Sight, a joint initiative of the World Health Organization (WHO) and the International Agency for the Prevention of Blindness (IAPB) aims to eliminate avoidable blindness in the world by the year 2020 [1]. It is estimated that over 90% of the world's visually impaired live in developing countries,[2]. And according to the National Programme for Control of Blindness & Visual Impairment (NPCBVI),As per Survey in 2001-02, prevalence of blindness is estimated to be 1.1%. Rapid Survey on Avoidable Blindness conducted under NPCBVI during 2006-07 showed reduction in the prevalence of blindness from 1.1% (2001-02) to 1% (2006-07). Various activities/initiatives undertaken during the Five year Plans under NPCBVI are targeted towards achieving the goal of reducing the prevalence of blindness to 0.3% by the year 2020.

As mentioned earlier, Cataract is the leading cause of treatable blindness worldwide and 75% of people with cataracts live in developing countries where blindness is associated with considerable disability, and major economic and social consequences [8]. Of the total estimated 38 million blind people in the world, 9–12 million are in India [9]. Estimates report that 50%–80% of these people are blind because of cataract [10]. In addition to the backlog, an additional 3.8 million become blind each year because of cataract [11].

Age-related cataracts are a common condition and one of the most important causes of blindness [13]. Diet, smoking, and exposure to ultraviolet light are thought to be risk factors in the development of age-related cataract. In addition, some people may have a genetic predisposition to development of age-related cataract. Oxidative stress is also thought to be a factor in cataract development. Cataract remains a major cause of visual impairment in India, and free, hospital based cataract surgery camps continue to be held to deal with the problem.

Due to improvements in medical technology and surgical instruments, phacoemulsification has now become a mainstream treatment for cataracts. Cataract surgery has gradually evolved from blindness prevention surgery to refractive surgery, with the aim of not only restoring vision but also improving visual quality and quality of life. The choice of surgical incision plays a crucial role in the efficacy of surgery, as the incision damages the surrounding tissues and affects the surgical approach. The size of microincisional phacoemulsification surgery (MICS) incisions ranges from 1.8 mm to 2.8 mm, whereas standard-incision phacoemulsification surgery (SICS) incisions range from5.0 mm to 6.0 mm [14]As the field of cataract surgery has trended towards minimally invasive approaches in recent years, some scholars now hold the view that smaller incisions contribute to less surgically induced astigmatism (SIA) [15] and hasten healing of the incision, thus leading to faster post-surgical recovery [16].

Now the parameters on which we are comparing Msics over phacoemulsification are the Corneal endothelial cell health.The mean endothelial cell count (ECC) and the Cell density (CD). Morphological stability and functional integrity of the corneal endothelium are necessary to maintain long-term corneal transparency after cataract surgery. The mean endothelial cell count (ECC) and the Cell density (CD) in the normal adult cornea ranges from 2000 to3000 cells/mm2, and the count continues to decrease with age. Previous cross-sectional studies have shown the normal attrition rate of corneal endothelial cells is 0.3-0.5% per year. Endothelial cell loss and corneal decompensation after cataract surgery is well-documented. All surgical procedures that involve entry into the anterior chamber damage a proportion of endothelial cells through intraoperative corneal manipulation. After endothelial cell loss, the adjacent cells enlarge and slide over to maintain endothelial cell continuity, which is observed as a change in the endothelial cell density and morphology. Moderate damage to the endothelium during surgery leads to a transient increase in corneal thickness. The damage to the corneal endothelium leads to corneal endothelial cell loss which if severe can eventually lead to the development of corneal edema.

Endothelial cell density and function can be assessed clinically using specular microscopy. In normal population to assess the response of the endothelium to cataract surgery, studies have shown a decrease in the endothelial density over a 3-month period postoperatively, with an increase in the coefficient of variation and decrease in the percentage of hexagonal cells. In India, approximately 5 million cataract surgeries are performed per year; therefore, it is important to determine the safest surgical technique for the endothelium. So as to minimize the post op corneal edema and improve post op visual outcomes.

There is a paucity of data from India on the effect of small-incision cataract surgery (SICS) and phacoemulsification on the corneal endothelium (morphological and functional) to assess the postoperative endothelial cell loss and change in endothelial morphology over a short period of time between the two commonly performed cataract techniques.

The current study is being undertaken for the evaluation and assessment of endothelial cell count loss in the two most commonly performed surgeries for cataract in India, namely, phacoemulsification and Manual small incision cataract surgery (MSICS)[17].

Successful cataract surgery depends on the good endothelial count pre operatively and post operatively. This observation of corneal endothelium by specular reflection dates back to the early past of 20th century.[18] Vogt demonstrated the first direct visualization of corneal endothelial cells using principle of specular microscopy in 1918 using S/L bio microscope.[19] We hope that this corneal endothelial study

helps us to chose an ideal technique for extraction of cataractous lens in order to get a good visual rehabilitation in 2 immediate post operative period as mentioned by our pioneer -our ultimate goal.[20]

The main objective of the current study was to assess the corneal endothelial cell count pre and post cataract surgeries at Department of Ophthalmology Nims university, Jaipur. The study has evaluated and quantified the corneal endothelial cell loss related to this commonest intraocular surgery. Therefore, the study has raised awareness to the surgeons on the importance of pre and post operative evaluation of patients for cataract surgery which is going to contribute towards the efforts of the hospital on improving the quality of cataract surgery on individual basis.

Inclusion Criteria

Age : 40-80 years
Sex : Both Sex Selected
Patients diagnosed with Age Related Cortical or Nuclear Cataract (up to NS II-III) and Scheduled for Cataract Surgery

Exclusion Criteria

Subjects with Active Eye Disease
History of Serious Eye Injury
History Prior Eye Surgeries
Known cases of Diabetes
Another cause of Decreased Vision (e.g, Glaucoma or Retinal pathology, Pseudoexfoliation)
A preoperative endothelial cell count of less than 2000 cells/mm2.
Intraoperative conversion of surgical technique from phacoemulsification to MSICS
Intraoperative posterior capsular rupture with vitreous loss
Those unable or unwilling to provide informed consent
Those who are not willing for the follow up were excluded from the study

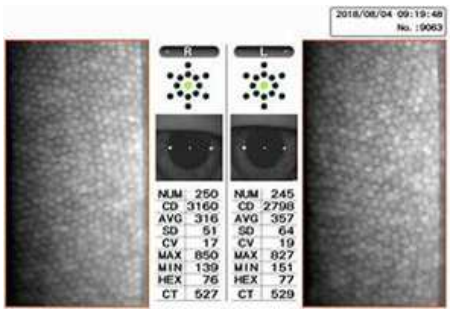
Methodology

Patients visiting NIMS Ophthalmology OPD for cataract surgery were selected Detailed history was obtained regarding systemic and ocular conditions.

Patients were then selected based on inclusion and exclusion criteria. Informed consent was obtained. Patients operated by a Single surgeon with a fixed technique were selected.

Preoperative and postoperative (First, Third and Sixth week) Corneal Endothelial Parameters were noted. The final data was compared with each other. Statistical analysis was done and results are obtained.

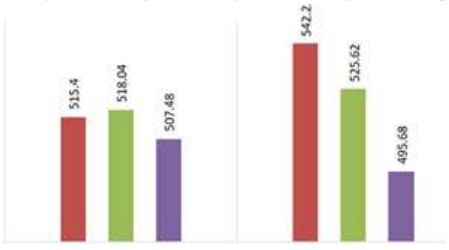
Specular Microscope



OBSERVATION AND RESULTS

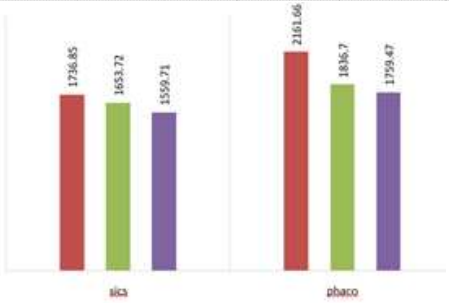
CCT comparison between the two groups

	Group	N	Mean	Std. Deviation	P value
CCT-Post OP	SICS	50	542.2200	45.32277	0.000
1st week	Phaco	50	515.4000	32.45759	
CCT-Post OP	SICS	50	525.6200	41.19130	0.152
3rd week	Phaco	50	518.0400	32.96001	
CCT-Post OP	SICS	50	495.6800	39.24383	0.032
6th week	Phaco	50	507.4800	37.93654	



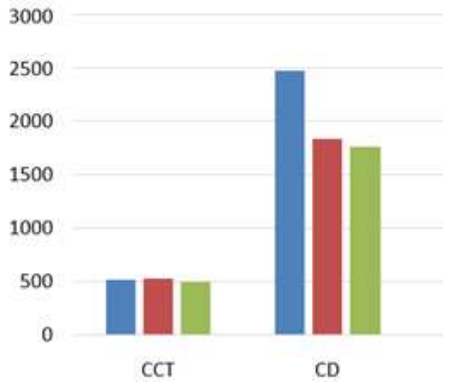
Endothelial cell density comparison between the two groups

	Group	N	Mean	Std. Deviation	P Value
CD /mm2 -Post OP	MSICS	50	2161.6634	405.59956	0.000
1st week	Phaco	50	1736.8500	648.82337	
CD /mm2 -Post OP	MSICS	50	1836.7030	391.61942	0.005
3rd week	Phaco	50	1653.7200	546.27567	
CD /mm2 -Post OP	MSICS	50	1759.4752	377.69068	0.007
6th week	Phaco	50	1559.7100	599.14905	



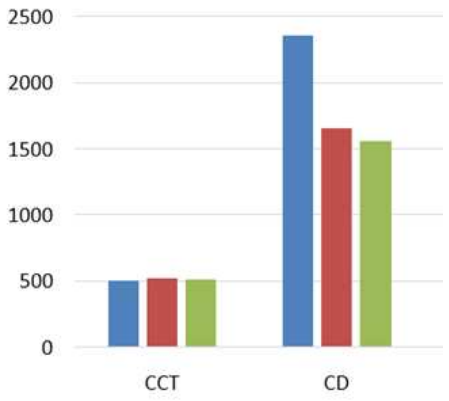
Comparison Of Endothelial Cell Parameters In Preoperative With Third And sixth Week Postoperative In MSICS group.

	Mean	Mean diff	Mean diff %	Std. Deviation	P value
CCT-Pre-OP	509.2079			39.13421	
CCT-Post OP 3rd week	526	16.7921	3.29769	41.16236	0.000
CCT -Post OP 6th week	495.9505	-13.2574	-2.60353	39.141	0.000
CD /mm2-Pre-OP	2473.743			173.1362	0.000
CD /mm2 -Post OP 3rd	1836.703	-637.04	-25.7521	391.6194	
CD /mm2 -Post OP 6th	1759.475	-714.27	-28.874	377.6907	0.000



Comparison Of Endothelial Cell Parameters In Preoperative With Third And Sixth week Postoperative In Phacoemulsification.

	Mean	Mean diff	Mean diff %	Std. Deviation	P value
CCT-Pre OP	496.31			32.46683	0.000
CCT-Post OP 3rd week	518.04	21.73	4.378312	32.96001	
CCT-Post OP 6th week	507.48	11.17	2.250609	37.93	
CD /mm2-Pre OP	2354.24			276.1577	0.000
CD /mm2 -Post OP 3rd week	1653.72	-700.52	-29.7557	546.2757	
CD /mm2 -Post OP 6th week	1559.71	-794.53	-33.7489	599.1491	



DISCUSSION

In our study conducted in a tertiary care hospital, a sample of 200 patients who were willing for cataract surgery were selected based on the inclusion and exclusion criteria. 2 groups of each 100 patients were selected based on patient's surgery preference as MSICS or phacoemulsification. All patients underwent specular microscopy before the surgery and postoperatively in the first , third and sixth week.

In our study, patients who underwent MSICS had mild increased CCT and decreased CD values post operatively. Whereas there was a significant increase and consecutive fall in CCT, with decrease in CD noted in patients who underwent phacoemulsification.

The mean age of MSICS patients is 65.56 years ± 8.61. The mean age of phacoemulsification patients being 63.64 years±8.52.

In MSICS the mean preoperative CCT was 496.31 and third week and sixth week postoperative CCT being 518.04 and 507.48. The difference of CCT with preoperative with postoperative third week and sixth week , showed a increase of 21.73 , and 11.17 respectively.

In phacoemulsification the mean preoperative CCT was 509.20, third week and sixth week postoperative CCT being 526 and 495.95. The difference between preoperative and postoperative CCT in the third week and sixth week was 16.79 and 13.25 respectively.

On comparing preoperative with postoperative CCT values of MSICS and phacoemulsification, there was increase in CCT in both the groups in the third post operative week followed by decrease at sixth weeks follow up.

This inference in our study is similar to study by Deshpande et al stating that there is increase in CCT in MSICS and phacoemulsification post operatively. They compared the CCT values in patients who underwent cataract surgery (50 MSICS and 50 phacoemulsification). There was significant increase in CCT in both 7th day and 30th day postoperatively. CCT in 7thand 30thpostoperative day in MSICS patients were 528.96 and 514.15 respectively and in phacoemulsification being 533.78 and 524.9. this states that there is an increase in CCT in both MSICS and phacoemulsification postoperatively.

Micheali et al also conducted a study comparing CCT and endothelial change after, in 51 patients who underwent phacoemulsification with clear cornea and scleral tunnel incision and their central corneal thickness measured preoperatively and on post-op days 1, 7, 30 and 90. Their corneal thickness increased significantly in all measurements post-op, and returned to baseline by 3 months. As stated in the study the CCT may reach the baseline by the end of third month. But in our study we have not analyzed post operative CCT up to third month, thus we are unable to conclude the restoration of corneal thickness to the baseline value.

Kosrirukvongs et al compared study of CCT and endothelial cell loss in divide and conquer with chip and flip in 41 eyes, specular microscopy was done at one week, one and third month postoperatively. This study noted there was increase in corneal thickness and greater endothelial loss in chip and flip compared to divide and conquer In MSICS the mean preoperative CD was 2354.24, the postoperative CD for third week and sixth week being 1653.72 and 1559.71. The difference in CD preoperative with post-operative third week and sixth week, showed a decrease of 700.52 cells/mm^2(29.75%) and 794.53 cells/mm^2 (33.74%) respectively.

In phacoemulsification the mean preoperative CD was 2473.74 and third- and sixth-week postoperative values was 1836.73 and 1759.47 respectively. While comparing preoperative CD with post-operative CD for third week and sixth week, the CD showed a decrease of 637cells/mm^2(25.75%)and 714.26 cells/mm^2(28.8%)respectively.

On comparing MSICS and phacoemulsification the CD values decrease in both the groups. Cataract surgery has been known to be associated with decrease in endothelial cell density and alteration of cell morphology. The percentage endothelial cell loss was found to be significantly less with MSICS compared to Phacoemulsification.

In correlation with our study, a study by Ganekal et al, where they compared the morphological and functional endothelial cell changes after MSICS versus phacoemulsification cataract surgery(chop technique) in around 200 patients using non-contact specular microscope. They found a statistically significant difference in endothelial cell density at 1 week and 6 weeks between the 2 groups.

Storr-Paulsen et al compared endothelial cell damage after phacoemulsification using divide and conquer or phacoemulsification chop nuclear fracturing technique in 60 patients. Endothelial cell loss was measured postoperatively and at 3rdand 12th month. Both groups had a significant but equal decrease in cell density contradicting the popular hypothesis that phacoemulsification chop technique is less harmful to the corneal endothelium than divide and conquer.

CONCLUSION

From above study it can be concluded that there occurs significant endothelial cell loss in both group of patients who underwent cataract surgery either SICS or Phacoemulsification. Maximal cell loss was seen in immediate post op period. Loss was found to be slightly higher in phaco group but the difference of cell loss between two groups was found to steadily decline during fourth week interval. Hence it can be concluded that Manual SICS surgery still remains a safe surgery in hands of experienced surgeon, economical with shorter learning curve

especially in set up like ours.

Limitations Of Study

Above study could have been more yielding in terms of outcome if we had a longer study duration, more number of recruited patients and a longer follow up post operatively. Along with that if the technique used for surgeries were also taken into consideration.

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