ORIGINAL ARTICLE

Effect of Incision Site on Corneal Endothelial Cell Count Changes in Cataract Surgery by Phacoemulsification

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ABSTRACT

Objectives: A comparison was made between scleral tunnel incision and clear corneal incision for their effect on corneal endothelial cell count changes in cataract surgery by phacoemulsification.
Subjects and methods: 100 patients included in this study were selected from outpatient department of LRBT Eye Hospital and randomly divided into two groups. Group A received scleral tunnel incision and Group B received clear corneal incision. Preoperatively, specular microscopy was performed to count corneal endothelial cells. Postoperative follow up was performed at 1st day, 1 week, 6 week and 3 month.
Results: Scleral tunnel incision group resulted in 6.44% ± 0.62% mean cell loss 3 month postoperatively. Mean cell loss 3 month postoperatively was 8.39% ± 0.61% by clear corneal incision.
Conclusion: Compared with clear corneal incision, scleral tunnel incision was associated with lower postoperative endothelial damage.
Key words: Cataract, Endothelial cell loss, Incision, Phacoemulsification.

INTRODUCTION

Cataract is defined as any congenital or acquired opacity in the lens capsule or substance, irrespective of the effect on vision[1]. Cataract is the world's leading cause of preventable blindness affecting an estimate of 20 million people. This figure is expected to increase near about 50 million by the year 2020 if no additional interventions are implimented.[2] 75% of the global blindness occurs in Asia and Africa. In Pakistan cataract contributes to 66.7% of the total blindnss.[3] Cataract surgery is the leading intraocular surgery being performed these days[4].

Small incision suture less cataract surgery has revolutionized the surgical procedure with minimal postoperative complications, swift visual rehabilitation and mobility of patient[5]. There is a better postoperative visual acuity in patients who underwent phacoemulsification than those who underwent extra capsular cataract extraction (ECCE) at all postoperative intervals[6]. Phacoemulsification is almost universally used today[7]. Phacoemulsification by scleral tunnel incision results in less postoperative endothelial damage than that with clear corneal incision[8].

The cornea is an excellent example of the unification of the structure and function that combine to yield an almost perfectly transparent avascular optical tissue that also serves as a barrier between the environment and the inside of the eye. Evaluation of the corneal endothelial status before cataract surgery is important[9]. During phacoemulsification endothelial cell loss depends upon many factors[10]. Few of these are the size and site of incision, technique of phacoemulsification, hardness of the cataract, irrigation fluid and viscoelastic material used, and skill of the surgeon.

A healthy cornea contains about 3000 cells per square millimeter. With pathologic cellular damage or substantial reduction in cell density from a normal value between 1400 and 2500 cells/mm^2 to a critical value of approximately 400 to 700 cells/mm^2, the endothelial transport capability becomes overwhelmed, and chronic stromal edema can ensue[11].

The corneal specular microscope is a reflected light microscope that projects light onto the cornea thus imaging the light reflected from an optical interface of the corneal tissue, most typically the interface between the corneal endothelium and aqueous humour. Depending on the instrument used, the projected light can be in the form of a stationary slit, a moving slit, or a moving spot. The optical design can either be confocal or non confocal[12].

The primary importance in clinical specular microscopy is the light that is reflected specularly (mirror like) where the angle of reflection is equal to the angle of incidence[13] This reflected light is captured by the clinical specular microscope and forms the endothelial image.

The Konan Noncon Robo Specular Microscope is the most automated instrument yet developed;

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tracking the cornea and imaging the endothelium are fully automatic requiring minimal intervention by the operator. The optics of the instrument first objectively aligns itself relative to the cornea by using the Purkinje images until the proper specular reflection mode is achieved.

Purpose of this study was to compare the changes in endothelial cell count during phacoemulsification by scleral tunnel incision and clear corneal incision while keeping the other variables constant.

MATERIAL AND METHODS

The study was conducted at LRBT Eye Hospital Lahore from September 2009 to March 2010.One hundred patients having visually significant cataract (Nucleosclerosis +2/+3) were selected from out-patient department of LRBT Eye Hospital and enrolled. Patients were asked to sign the informed consent. The patients were randomly allocated in two groups by using random number tables. Group A was operated by scleral tunnel incision and group B was operated by clear corneal incision. Sociodemograhic profile like name, age, gender and history of current disease with respect to symptoms, severity and duration was taken. (Table1). Examination included detailed anterior segment examination with slit lamp, visual acuity with Snellen's chart, intraocular pressure measurement with Goldmann's applanation tonometer and dilated fundus examination. Preoperative specular microscopy was carried out with Konan Noncon Robo specular microscope to count corneal endothelial cells. (Table No. 2).

All patients were operated upon under local anaesthesia (retro bulbar injection) by using 1:1 mixtures of 2% Lidocaine and 0.5% Bupivacaine HCL. Surgery was performed under strict aseptic measures. Scleral tunnel incision started 2 mm posterior to supro-temporal limbus. A scleral tunnel was dissected and the anterior chamber entered with a 3.2 mm angled slit knife. Clear corneal incision was also located at supro-temporal limbus. The incision entry point was 0.50 mm into clear cornea. The incision was made with a 3.2 mm angled slit knife starting at about half of corneal thickness and creating a 3.2 mm wide, 1.75 to 2.00 mm long tunnel into the clear cornea. A stab incision was made at the end of the tunnel to penetrate the anterior chamber. After an uneventful phacoemulsification, both incisions were enlarged to 5.5 mm wide and a rigid PMMA IOL was implanted in the capsular bag. Phaco power, viscoelastic, irrigation solution and intraocular lens were kept constant in all patients.

Postoperatively all patients were sent to home with a sterile eye pad on the operated eye. Next morning pad was removed under aseptic measures and complete postoperative examination carried out. Each patient received a combination of Tobramycin 0.3% and 0.1% Dexamethasone eye drops six times per day. The medicines were tapered in 6 weeks duration. Follow up by specular microscope was carried out at 1st day, 1 week, 6 week and 3 month.

RESULTS

In this study a comparison was made between scleral tunnel incision and clear corneal incision for their effect on corneal endothelial cell count changes in cataract surgery by phacoemulsification.

In group A, mean preoperative endothelial cell count was 2695.30 cell / mm^2, ranging from 2215 to 2896 cell / mm^2, with standard deviation of 131.43 cell / mm2. In group B, mean endothelial cell count was 2665.82 cell / mm^2, ranging from 2234 to 2994 cell / mm^2, with standard deviation of 241.87 cell / mm^2 (Table no: 2). There was no statistically significant difference in preoperative endothelial cell counts in two groups, p value = 0.467.

In group A, first post operative day mean endothelial cell count was 2553.70 cell / mm^2, ranging from 2075 to 2751 cell / mm^2, with standard deviation of 124.32 cell / mm^2. The mean cell loss was 5.27% (4.75-7.23%) with standard deviation of 0.64%. In group B, first postoperative day mean endothelial cell count was 2476.12 cell / mm^2, with range of 2079-2802 cells / mm^2 and standard deviation of 224.50 cell / mm^2. The mean loss was 7.09% (5.95-7.80%) with standard deviation of 0.55% and a statistically significant difference of p=0.045.

In group A, third postoperative month mean endothelial cell count was 2515.70 cell / $mm^{2,}$ ranging from 2047 to 2704 cell / $mm^{2,}$ with standard deviation of 125.93 cell / $mm^{2.}$ The mean loss was 6.44% (5.90-8.29%) with standard deviation of 0.62%. In group B, third postoperative month mean endothelial cell count was 2436.92 cell / mm^2, with range of 2047-2770 cells/mm^2 and standard deviation of 228.50 cell / mm^2. The mean loss was 8.39% (6.89-9.75%) with standard deviation of 0.61 %. (Graph 1 & 2). There was statistically significant difference (p=0.039) in third postoperative month endothelial cell counts between the two groups.

Table 1: Demographic data

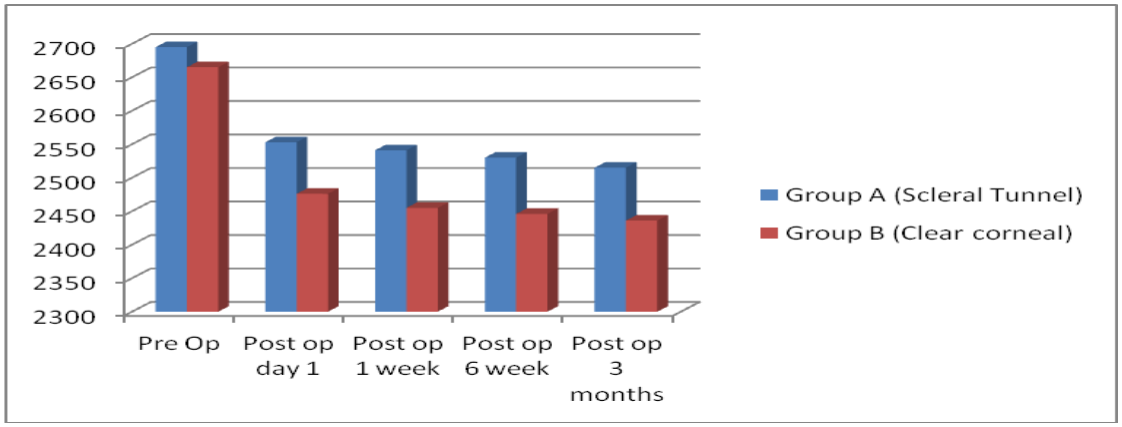
	Group A (n=50)	**Group B (n=50)**
Age	45-65 Years mean 54.76	45-65 Years mean 54.88
Gender	Male. 21 (42%) Female. 29 (58%)	Male. 23 (46%) Female. 27 (54%)
Laterality	Right Eye. 27 (54%) Left Eye. 23 (46%)	Right Eye. 29 (58%) Left Eye. 21 (42%)

Table 2: Preoperative endothelial cell count (n=100)

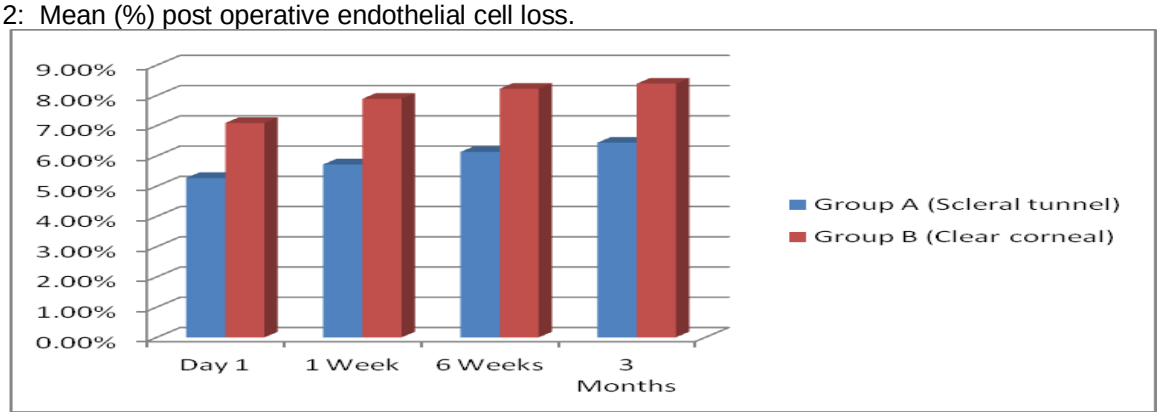
Group	=n	Range (cells/mm^2)	Mean (cells/mm^2)	SD (cells/mm^2)	p value
A(sclera tunnel)	50	2215-2896	2695.30	131.403	0.467
B(clear corneal)	50	2234-2994	2665.82	241.87	

p value > 0.05 is not significant

Graph 1: Mean endothelial cell count.



Graph 2: Mean (%) post operative endothelial cell loss.



DISCUSSION

The normal thickness and transparency of the cornea are maintained by the barrier function and the active fluid pump of the corneal endothelium[14]. Corneal endothelial cells can be damaged by many factors during and after cataract surgery. Intraoperative factors associated with corneal endothelial injury include bubble and free radical formation during phacoemulsification, ultrasound energy, mechanical trauma by instruments, presence of lens fragments and intraocular lens. Endothelial alterations are considered important parameters of surgical trauma and are essential in estimating of surgical techniques[15].

There was no statistically significant difference in preoperative endothelial cell counts between the two groups. There was statistically significant difference in post operative endothelial cell counts between the two groups at all follow up visits. Scleral tunnel incision group resulted in 6.44% ± 0.62% mean cell loss 3 month postoperatively. Mean cell loss 3 month postoperatively was 8.39% ± 0.61% by clear corneal incision. The result clearly showed that scleral tunnel incision was less damaging to the endothelial cells.

In this study a progressive decrease in cell density was noted during the three month follow up. It is emphasized that it is not clear how long it takes the endothelial cell count to stabilize after cataract surgery. There are reports of cell loss stabilization three months after uneventful cataract surgery[16, 17]. There is evidence of continuing cell loss even several

years after surgery despite apparent normalization of endothelial morphologic characteristics[18,19].

The results in the literature on mean cell loss after phacoemulsification are not homogenous. Other studies of uneventful phacoemulsification report a mean endothelial cell loss of 12.03%[89], 18.3%[90]and 8.5% three months after a superior limbal incision[20]. Kohlhass and coauthors [21] report an approximate 18% cell loss at the center and 27% at the 12 o' clock position 1 year after phacoemulsification.

Ravalico et al, in a study of 40 cases, have assessed the endothelial function after ECCE and phacoemulsification. They found a decrease in endothelial cell density at 30 days post surgery by 10.1 % in cases of ECCE and 8.5 % in cases of phacoemulsification[22].

One study conducted by Werblin TP demonstrated that routine uncomplicated phacoemulsification surgery demonstrated a 9% endothelial cell loss 1 year postoperatively. [23]It is difficult to compare our results with these data for two reasons. First Intraoperative and postoperative endothelial injury depends on a combination of factors[24]. Second specular microscopy can determine the cell count with a standard deviation of 5.0%[25] and calculating endothelial cell loss can be difficult[26].

For the same size scleral tunnel incision our data showed less endothelial cell damage (6.44% ± 0.62%) than the data of Diaz-Valle et al[27] who reported a mean cell loss of 11.8% three months after 5.5 mm scleral tunnel phacoemulsification. For the same size temporal clear corneal incision, our results, 8.39% ± 0.61% mean cell loss, appears similar to the results of Dick and coauthors[28] who found a mean reduction in endothelial cellular density of 7.9%.

This study showed less endothelial cell loss as compared to the results of Giorgio Beltrame and coauthors[29]. They reported mean endothelial cell loss of 22% by 5.5mm clear corneal incision at 3 month follow up. They also reported 17% mean endothelial cell loss by scleral tunnel incision at 3 month follow up. Scleral tunnel incision resulted in statistically significant less postoperative endothelial cell loss as compared to clear corneal incision. Our result was comparable to the result of Giorgio Beltrame and coauthors[29] as in our study scleral tunnel incision resulted in less endothelial loss than the clear corneal incision.

We believe, as suggested by others[30], that the higher cell loss in the clear corneal incision group might be caused by mechanical trauma from the phaco tip or instruments used to insert IOL, despite the use of viscoelastic material. Compared with clear corneal incision, scleral tunnel incision was associated with lower postoperative endothelial damage. This is probably because the scleral tunnel is more posterior and therefore induces less direct (e.g., phaco tip, IOL implantation) and indirect (mechanical corneal striae) trauma.

CONCLUSIONS

The study shows that phacoemulsification is a safe procedure in experienced hands Compared with clear corneal incision, scleral tunnel incision is associated with lower postoperative endothelial damage .It is suggested that scleral tunnel incision should be used in patients at risk for endothelial damage in cataract surgery.

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