

# A Novel Approach to Prevent Endothelial Tear/Detachment in Combined Advanced Pseudoexfoliation Syndrome and Diabetes Mellitus

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## Abstract

**Objective:** To find a novel way to prevent endothelial tear/detachment during phacoemulsification in pseudoexfoliation combined with diabetes mellitus undergoing phacoemulsification.

**Introduction:** The cornea is lined by only one layer of hexagonally shaped, uniformly sized cells internally, which is called the endothelium. The endothelium can be affected by many factors, like the aging process, pseudoexfoliation (PXF) and diabetes mellitus. The combination of more than two factors could have a loosening effect on the endothelial attachment to its basement membrane.

**Subject and method:** The current study is an interventional clinical trial one, which comprises of 43 patients with 84 eyes. All of them had diabetic retinopathy and pseudoexfoliation. They divided into three groups:

Group A a clear corneal incision for the side port and the main incision done.

Group B both incisions performed at the limbus.

Group C scleral tunnel for both incisions.

**Result:** The age of the groups was 58–83 years with a mean of 70.5 years. The gender distribution was 10.7% males and 89.3% females, but the p-value showed non-significant p-value between the gender distribution and both the tear and detachment.

Group A endothelial detachment in the main incision and tear at the side ports.

Group B endothelial tear both side ports and main incision.

Group C neither tear nor detachment happened in almost all cases.

**Conclusion:** The study has shown that combined Advanced PEX and DM carries a very high risk for endothelial damage; therefore, scleral tunnel instead of all the corneal incisions provides a novel approach to prevent endothelial tear/detachment in such cases.

**Keywords:** Pseudoexfoliation (PXF) cataract surgery; Phacoemulsification; Diabetic cataract surgery; Endothelial tear; Endothelial detachment

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## Introduction

The human's cornea is lined by only one layer of hexagonally shaped, uniformly sized cells internally, which is called the endothelium [1]. The account reduces by nearly one to two hundred cells per year with the aging process [2], which by time causes dysfunction of the endothelium, despite the aging process the decrease in the cell count can be counted with contact lens wearer and in myopics, conducted by Chang SW et al. and Urban

et al. [3,4]. But, Bourne WM et al. showed in their study, that the decreasing in the number of endothelial could also happen secondary to a surgical injury in the anterior chamber [5]. Many studies showed that a trivial change in the hexagonal shaped cell could disrupt the tight junction of the endothelium. The corneal endothelial cells when lost, it did not regenerate and compensated by expanding the cells, which cause a disturbance in the tight junction and cause corneal edema. At the same time, Ha Thi BM et al. study's demonstrated in vitro that the endothelial

cell shows mitotic activity [6].

Both types of diabetes mellitus virtually affect the retina, but chronic and prolonged high glucose level can affect all organs including the cornea; therefore, changes in multiple layers noted both morphologically and functionally, collectively disturbing its transparency; the endothelial layer is the most considerable one, conducted by Larsson et al, Keolein et al, Kabosova et al and Didenko et al [7-10].

The pseudoexfoliation syndrome (PXF) regarded as an age-related disorder, in which there are degenerative changes in the extracellular matrix. It's a systematic microfibrilopathy, affecting eyes and other organs like hepatobiliary system, respiratory system, kidney, meningeal layers and around the vasculature systems. In the eye, it deposits mostly on the lens capsule and iris, ciliary body, zonular fibrils and corneal endothelial layer, revealed by Aboobakar et al and Elhawy et al [11,12].

Studies have shown that in PXF illness, the corneal endothelial are abnormal or unstable, which is more susceptible to the impact of raise intraocular surgeries or increasing in the IOP, Yu et al [13].

## Methods

The current study is an interventional clinical trial one, which comprises of 43 patients with 84 eyes. This study carried out by the same surgeon and the permission and approval confirmed by the local ethics committee under the number 632.

All of the cases had diabetic retinopathy with PXF on the anterior capsule in the form of sheet-like and around the pupillary border [1].

**Regarding the surgical technique;** it is performed after instilling anesthetic eye drop and subconjunctival anesthesia using 2% lidocaine 0.3 ml, the incisions done according to the groups:

**Group A,** a clear corneal incision for the side port and the main incision done.

**Group B,** both incisions performed at the limbus.

**Group C,** scleral tunnel incision for both incisions.

The Scleral tunnel for the main incision carried out with 2.8mm keratome, the length of the channel was about 1.5-2mm, but the base wound length was nearly double-sized keratome to allow more free movement of the phacoemulsification probe to decrease the tension on the phacodonesed lens, the conjunctiva at the wound edge was more incised to prevent conjunctival swelling. Then, the pupil dilated with the help of iris retractor, followed by capsulorhexis and hydro dissection, then primary vertical chop-stop done for almost all cases in one session (without re-insertion of the phacoemulsification probe and the chopper). Then the IOP was lowered to below 15 mmHg because, in some patients, exacerbation of the zonulolysis were noted when IOP was more than 15 mmHg, could indicate tunnel pressure on the zonules!. Followed by coaxial irrigation/aspiration and foldable lens insertion. In the tear or detachment cases; the anterior chamber formed with air for re-attaching the tear or the detachments. Both of the Group A and B developed dense edema at the incision sites with the less severe edema in

the center, were resolved between 2-3 weeks after Hypertonic saline eye drop 5%. All groups had received the same combination of antibiotics and steroids in the form of eye drops and ointment for one month.

The data analyzed with SPSS version 25, ANOVA and chi-square used.

## Result

The age of the groups was 58–83 years with a mean of 70.5 years. The gender distribution was 10.7% males and 89.3% females, but the p-value was non-significant between the gender distribution and both the tear and detachment, **Table 1.** The mean value of HbA1c was 6.5 pre-operatively. All Glaucoma patients had controlled intraocular tensions (IOP) with a mean of 18 mmHg.

**Table 1.** showing the ANOVA and Chi-square correlation with the variables.

Variables Between groups and within groups	ANOVA P-value	Variables	Chi-square P-value	Decision
Endothelial Tear	0.000	Endothelial Tear	0.00	VHS
Endothelial detachment	0.000	Endothelial detachment	0.00	VHS
Age	0.32	Age	0.78	NS
Glaucoma	0.195	Glaucoma	0.190	NS
Gender	0.933	Gender	0.931	NS

**Group A,** a clear corneal incision for the side port and the main incision done for the first 15 cases, in which detachment occurred for about 1-1.5mm in the main incision but only tear at the side ports.

**Group B,** both incisions performed at the limbus for 21 cases, the endothelial tear occurred about less than 1mm; in 7 cases were at the both of incisions, while the remaining 14 cases developed tear only at the main incision sites.

**Group C,** scleral tunnel performed for both of the incisions, for the 47 cases, neither tear nor detachment seen in almost all cases.

## Discussion

Up to our knowledge, no report available for the behavior of the corneal endothelium during phacoemulsification surgery in patients having advanced diabetes and PXF disease. One of the crucial steps during the surgery is how to preserve endothelial layer from been damaging. Therefore, there are many factors; like surgeon's factor; when an inexperienced surgeon performs the surgery can hurt the endothelium whether by utilizing excessive phacoemulsification power or by too much instrumentation all collectively can damage the endothelial layer in a different way like loss of the cell count, tear or detachment. The patient's factor includes diseases that affect the endothelium; the most common conditions are diabetes and PXF; also the grade of the cataract, the depth of the anterior chamber, pupil dilatation as shown by Hasegawa et al. in their study [14]; even when an experienced surgeon operated on, might face some complications.

The patients expected to have their vision in the first postoperative days, but in uneventful operation, the immediate visual recovery depends on the remaining endothelial cell count, as conducted by Kaup et al [15] specially in combined diseases that left unhealthy endothelium even when the procedure performed with a very qualified surgeon and an ideal phacoemulsification machine with an ideal duration; therefore, an optimal approach should be used when we face such complicated cases, i.e. the standard steps in the phacoemulsification procedure might not be suitable for all cases, revealed by Cavallini et al. study [16], therefore, when these procedures are not optimizing the outcomes for both surgeons and patients, the defect should be isolated, studied and appropriately managed. Here, it was detachment and tear; therefore, the current study directed new steps to bypass the unwanted event to happen to the endothelium, by performing this new technique with excellent outcomes.

All the reports are mentioning a decreased endothelial cell count in PXF specially with high phacoemulsification power, shown by Kaljurand and Teesalu in their study [17], diabetes, Fernández-Muñoz et al [18] or even in a normal person after

phacoemulsification procedure, as shown by Asena and Kaskaloglu [19].

In a normal eye, this endothelium is firmly attached to its basement membrane, the Descemet's membrane, Mimura et al [20]. Whether the presence of both diabetes and PXF in the same patient could have an impact on the adherent between the endothelium with it is basement membrane remains questionable needs more prospective.

## Conclusion

In this study, we conduct that combined Advanced PEX and DM carries a very high risk for endothelial damage; therefore, we strongly emphasize that the scleral tunnel instead of usual corneal incisions provide a novel approach to prevent endothelial tear and or detachment.

## Declarations

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**Conflict of interest:** None declared

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