



**COMPARATIVE STUDY BETWEEN THE EFFECT OF  
DIFFERENT CONCENTRATIONS OF METHYL  
CELLULOSE ON THE CORNEAL ENDOTHELIUM  
DURING PHACOEMULSIFICATION**

*Thesis*

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Ophthalmology*

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

لسببائك لا علم لنا  
إلا ما علمتنا إنك أنت  
العليم العظيم

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## **CONTENTS**

<b>Subjects</b>	<b>Page</b>
• List of Abbreviations .....	I
• List of table .....	II
• List of Figures .....	III
• Introduction .....	(1)
• Aim of the Work.....	(4)
• Review of literature: .....	(5)
Chapter 1: Anatomy of the Cornea.....	(5)
Chapter 2: Corneal Endothelium.....	(13)
Chapter 3: Ophthalmic viscosurgical devices .....	(28)
Chapter 4: Specular Microscopy.....	(40)
• Patients And Methods.....	(51)
• Results.....	(53)
• Discussion.....	(67)
• Summary and Conclusion.....	(73)
• References .....	(76)
• Arabic Summary .....	-

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## **LIST OF ABBREVIATIONS**

<b>AC</b>	: Anterior Chamber
<b>BCVA</b>	: Best Corrected Visual Acuity
<b>BME</b>	: Basement Membrane of the Epithelium
<b>CECs</b>	: Corneal Endothelium Cells
<b>cSt</b>	: Centistoke
<b>CV</b>	: Coefficient of Variation
<b>DM</b>	: Descemet membrane
<b>ECC</b>	: Endothelial Cell Count
<b>ECM</b>	: Extracellular Matrix
<b>GAGs</b>	: Glycosaminoglycans
<b>GAT</b>	: Goldmann Applanation Tonometer
<b>HPMC</b>	: Hydroxypropyl Methylcellulose
<b>I/A</b>	: Irrigation/Aspiration
<b>IMSC</b>	: Immature Senile Cataract
<b>IOL</b>	: IntraOcular Lens
<b>IOP</b>	: IntraOcular Pressure
<b>LOCS</b>	: Lens Opacity Classification System
<b>OH</b>	: Hydroxyl radical
<b>OHdG</b>	: 8-hydroxy-2-deoxyguanosine
<b>OVD</b>	: Ophthalmic Viscoelastic Devices
<b>PAS</b>	: Periodic Acid-Schiff
<b>PCL</b>	: Posterior Collagenous Layer
<b>SD</b>	: Standard Deviation
<b>SPSS</b>	: Statistical Package for Social Sciences
<b>SST</b>	: Soft Shell Technique
<b>US</b>	: Ultra Sound
<b>ZSV</b>	: Zero-Shear Viscosity [ZSV]

## LIST OF TABLES

<i>Tab. No.</i>	<i>Subject</i>	<i>Page</i>
<b>Table (1)</b>	Comparison between sex distribution in the study groups	54
<b>Table (2)</b>	Laterality distribution	55
<b>Table (3)</b>	Cataract grade distribution	56
<b>Table (4)</b>	Age distribution in the study groups	57
<b>Table (5)</b>	Best Corrected Visual Acuity in the two groups	58
<b>Table (6)</b>	Pre-Operative and Post-Operative IOP Comparison in the two groups	60
<b>Table (7)</b>	Pre-Operative and Post-Operative Endothelial Cell Count in the two groups	63

## LIST OF FIGURES

<i>Fig. No.</i>	<i>Subject</i>	<i>Page</i>
<b>Fig. (1)</b>	Transverse Section in the human Cornea	6
<b>Fig. (2)</b>	Corneal collagen lamellae	10
<b>Fig. (3)</b>	Scanning Electron Microscopy of Corneal Endothelium	13
<b>Fig. (4)</b>	Endothelial Cell Density by Age	16
<b>Fig. (5)</b>	Corneal endothelial pump mechanism	19
<b>Fig. (6)</b>	Fuchs' Endothelial Dystrophy	21
<b>Fig. (7)</b>	Cohesive Viscoelastic (Left) and Dispersive Viscoelastic (Right)	29
<b>Fig. (8)</b>	Properties and different roles of OVDs	34
<b>Fig. (9)</b>	Arshinoff Soft Shell Technique with 2 OVDs	35
<b>Fig. (10)</b>	Specular microscopy of a normal corneal endothelium.	40
<b>Fig. (11)</b>	Non contact Specular Microscope	43
<b>Fig. (12)</b>	Techniques in determining Endothelial cell density	50
<b>Fig. (13)</b>	Comparison between sex distribution in the study groups	54
<b>Fig. (14)</b>	Laterality distribution	55
<b>Fig. (15)</b>	Cataract grade distribution	56
<b>Fig. (16)</b>	Age distribution in the study groups	57
<b>Fig. (17)</b>	Pre-Operative and Post-Operative Best Corrected Visual Acuity in the two groups	58
<b>Fig. (18)</b>	Pre-Operative and Post-Operative Best Corrected Visual Acuity in the two groups	59
<b>Fig. (19)</b>	Pre-Operative and Post-Operative IOP Comparison in the two groups	60
<b>Fig. (20)</b>	Pre-Operative and Post-Operative IOP Comparison in the two groups	61
<b>Fig. (21)</b>	IOP Drop in the 2 groups	62
<b>Fig. (22)</b>	IOP Drop Percentage in the 2 groups	62
<b>Fig. (23)</b>	Pre-Operative and Post-Operative Endothelial Cell Count in the two groups	63
<b>Fig. (24)</b>	Pre-Operative and Post-Operative Endothelial Cell Count in the two groups	64

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*List of Figures*

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<i>Fig. No.</i>	<i>Subject</i>	<i>Page</i>
<b>Fig. (25)</b>	Endothelial cell loss in the two groups	64
<b>Fig. (26)</b>	Endothelial Cell Loss Percentage in the two groups	65

## ABSTRACT

**Objective:** To study the effect of different concentrations of methyl cellulose on the corneal endothelium during phacoemulsification using specular microscopy.

**Patients and Methods:** Sixty patients with Immature Senile Cataract (IMSC) in Department of Ophthalmology, Ain Shams University Hospital were equally distributed into two groups according to the concentration of Hydroxypropyl Methylcellulose (HPMC) used during phacoemulsification. The study duration was about six months. In the first group HPMC 2% was used and in the second group HPMC 2.4% was used. Preoperative and one month postoperative examination was done including visual acuity testing, slit lamp examination using Topcon SL-3C, intraocular pressure measurement using Goldmann Applanation Tonometer (GAT), fundus examination, corneal endothelium assessment by Tomey Specular Microscope EM-3000.

**Results:** Preoperatively, no significant difference was observed in age, sex, visual acuity, intraocular pressure and endothelial cell count among the two groups. Postoperatively, the two groups had a significant decrease in endothelial cell count, but the decrease was less in group 2 using Methyl cellulose 2.4% (13.494%) than in group 1 using Methyl cellulose 2% (14.515%). There was an equal and significant increase in visual acuity in the two groups.

**Discussion:** Many studies have been done to compare the efficacy of different viscoelastics (OVDs) in the protection of corneal endothelium during phacoemulsification. In our study we compared the protective effect of two different concentrations of Hydroxypropyl Methyl Cellulose (2% & 2.4%) on the corneal endothelium during phacoemulsification. We compared the demographic data as regarding age and sex of the patients in the two groups, also we compared the preoperative endothelial cell count in the two groups using Specular Microscopy and the result showed no significant difference between the 2 groups. The endothelial cell loss was comparable in the 2 groups, in group 1 it was  $362.267 \pm 52.020$  (14.515%  $\pm$  1.458) and in group 2 it was  $335.667 \pm 21.170$  (13.494%  $\pm$  0.667) with slightly better protection in the second group. So these results show that HPMC 2.4% gives better protection than HPMC 2% on corneal endothelium during phacoemulsification on terms of the postoperative endothelial cell count and the endothelial loss after phacoemulsification. Many studies have been done to compare the efficacy and the protective effect of different viscoelastics during phacoemulsification for example the studies done by Miller et al, Maar et al, Vajpayee et al and Storr-Paulsen et al, these studies showed results similar to our study as regards the protective effect of methyl cellulose with its different concentrations on the corneal endothelium during phacoemulsification, so both concentrations (2% and 2.4%) can be used safely and effectively in phacoemulsification to decrease the endothelial loss and ensure patients safety.

**Conclusion:** Methyl cellulose 2.4% and Methyl cellulose 2% were comparable in their ability to protect the corneal endothelium during phacoemulsification, in general both viscoelastics can be efficiently and safely used in performing phacoemulsification.

**Key words:** Corneal Endothelium, Viscoelastics, Phacoemulsification, Specular Microscopy.

## INTRODUCTION

The corneal endothelium is composed of a single layer of cells forming the posterior surface of the cornea. Anteriorly it is attached to the rest of the cornea by Descemet's membrane, and posteriorly it is contiguous with the anterior chamber of the eye<sup>(1)</sup>.

The endothelial layer of the cornea maintains corneal clarity by ensuring it remains in a relatively deturgescened state. Adjacent cells share extensive lateral interdigitations and possess gap and tight junctions along their lateral borders. The lateral membranes contain a high density of Na, K-ATPase pump sites<sup>(2)</sup>.

This deturgescence is mediated by a pump-leak process as fluid egresses from the corneal stroma down the osmotic gradient from a relatively hypo-osmotic stroma toward a relatively hypertonic aqueous humor.<sup>(3)</sup> The two most important ion transport systems are the membrane-bound Na and K-ATPase sites and the intracellular carbonic anhydrase pathway. Activity in both these pathways produces a net flux of ions from the stroma to the aqueous humor<sup>(4)</sup>.

Endothelial cell density continues to change throughout life. From the second to eighth decades of life, the cell density declines from 4000 cells/mm<sup>2</sup> to around 2600 cells/mm<sup>2</sup>, The central endothelial cell density

decreases at an average rate of 0.6% per year in normal corneas<sup>(5)</sup>.

Endothelial cells have no mitotic activity in vivo; however, humans are born with a significant reserve. It has been observed that eyes with endothelial cell counts below 500 cells/mm<sup>2</sup> may be at risk for the development of corneal edema. Endothelial cell morphology also appears to correlate with pump function. An increase in cell size (polymegathism) and an increase in variation of cell shape (pleomorphism) correlate to reduced ability of the endothelial cells to deturgesce the cornea<sup>(6)</sup>.

Specular microscopy is used to view and record the image of the corneal endothelium.<sup>(7)</sup> The clinical specular microscopes are all based on the laboratory microscope designed by Maurice to provide a high magnification view of specular reflected light from the corneal endothelium<sup>(8)</sup>.

The specular reflex occurs at a regular, smooth surfaced interface of two refractive indices with the light from the subject having an angle of incidence equal to the angle of reflection to the observer. The endothelial cells can be imaged because the refractive index of the endothelial cells is greater than the 1.336 value for aqueous humor, thus reflecting 0.022% of the projected light<sup>(9)</sup>.

Cataract surgery is one of the most frequently performed surgical interventions worldwide,<sup>(10)</sup> and within the last decades, tremendous improvements have been

made with regard to surgical techniques as well as applications of additive tools among others<sup>(11)</sup>.

In this respect, the use of ophthalmic viscoelastic devices (OVD) during the procedure has emerged into the focus of scientific and clinical interest, OVDs can be useful to maintain stability of the anterior chamber (AC) and can enlarge and stabilize pupil size in small pupils thus help to avoid posterior capsule rupture<sup>(12)</sup>.

OVDs may diminish large intraocular pressure (IOP) fluctuations during surgery. These fluctuations are likely a predisposing risk factor for expulsive hemorrhage, If an intraoperative posterior capsular defect occurs, OVDs can facilitate to push vitreous backward and assist to implant the intraocular lens (IOL) into the ciliary sulcus<sup>(13)</sup>.

One of the main aspects in OVD use remains the protection of intraocular structures and in particular of corneal endothelium cells (CECs) during cataract surgery, it is believed to protect the CECs during the phacoemulsification maneuver due to suppression of free radical formation<sup>(14)</sup>.

It also plays an eminent role in avoiding CEC contact with lens, iris, surgical instruments, and the IOL to be inserted during and after the implantation process, all of which can lead to a sustained CEC loss<sup>(15)</sup>.

## **AIM OF THE WORK**

To study the effect of different concentrations of methyl cellulose on the corneal endothelium during phacoemulsification using specular microscopy

## **ANATOMY OF THE CORNEA**

The cornea is an avascular, transparent, dome-shaped tissue that refracts light through the pupil to the lens and provides a protective, impermeable barrier against mechanical damage and infectious agents; it overlies the iris, pupil, and anterior chamber. The structures that compose the anterior chamber are surrounded by the white opaque sclera<sup>(16)</sup>.

The cornea has about +43 diopters and is the strongest lens of the eye. Its main function is to allow light to pass into the inner part of the eye. The average size of the human cornea is 11–12 mm horizontally and 9–11 mm vertically. It is approximately 0.5 mm thick, and the thickness increases gradually toward the periphery. The cornea is composed of six layers (Fig. 1): the epithelium and its basement membrane, Bowman layer, the stroma, Dua's Layer, Descemet membrane, and the endothelium<sup>(17)</sup>.