Comparative study of foldable intra ocular lens implantation in phacoemulsification by hydro implantation versus visco implantation

Thesis

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List of Abbreviations

BCDVA..................Best-Corrected Distance Visual Acuity

CS.........................Chondroitin Sulfate

CV.........................Coefficient of Variation

ECD ....Endothelial Cell Density

Healon D ....Healon Dispersive

Healon GV ....Healon with Greater Viscosity

HPMC ....Hydroxypropyl Methycellulose

IOLs......................Intra Ocular Lenses

IOP ....Intraocular Pressure

MVR ....Micro-Vitreoretinal Blade

NaHa.....................Sodium Hyaluronate

OVDS....................Ophthalmic Viscosurgical Devices

SD.........................Standard Deviation

SST.......................Soft-Shell Technique

UDVA....................Unaided Distance Visual Acuity

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ABSTRACT

Background: Viscosurgical devices created a revolution in progress of cataract surgery but with great advancement in cataract surgery and their corneal incisions, anterior chamber and bag stability can be achieved with other methods otherwise viscosurgical devices and the best method is hydro implantation. Hydro implantation can achieve the same effect like Visco implantation with achieving approximate safety on ocular structures especially corneal endothelium and posterior capsule.

Aim of the study: To compare the safety of a single-piece, foldable intraocular lens (IOL) hydro implantation with that of a standard implantation using an ophthalmic visco surgical device (OVD) on central endothelial cell density.

Patients and Methods: A total of 70 eyes of 70 patients were treated between July 2018 and January 2019 was enrolled in this study. The OVD was used for IOL implantation in group A (n = 35) (18 male and 17 female); in group B (n = 35) (16 male and 19 female), the hydro implantation technique was used.

Results: With advancement in phaco surgery especially in corneal incisions and IOL, field maintenance and anterior chamber stability have been achieved. Some surgeons advised IOL implantation without OVDs. Hydro implantation technique has been used. It can save time of OVDs injection before and after IOL implantation with non inferior safety.

Conclusion: Hydro implantation is a safe, effective, simple and inexpensive method of IOL implantation.

Keywords: Endothelial cell density, ophthalmic viscosurgical devices, soft-shell technique, intraocular pressure

1. Introduction

Various techniques to implant IOLs without or with minimal use of an (OVD) have reported by many studies, such as the use of the anterior chamber maintainer [1, 2], the empty-bag technique[3,4], and the ultimate soft-shell technique[5]. Many limitations have restricted usage of these techniques.

The implantation technique employing either balanced salt solution or air was used since 1980 [6]. However, implantation during that period was more difficult because the surgical wound was large. A collapse of the anterior chamber and prolapse of the iris occurred due to wound opening during IOL implantation.

The subsequent introduction of an OVD in cataract surgery and IOL implantation led to significant progress and improvement, especially in corneal endothelium protection. [7]

The main function of an OVD is to maintain the anterior chamber and protect intraocular tissue during the implantation process, especially the corneal endothelium. The protective effect of different types of OVDs on the endothelium during cataract surgery was described by many studies [7, 8]. Using more gentle approaches to surgery, such as phacoemulsification and a small corneal incision, the postoperative decrease of endothelial cell density (ECD) is relatively low, described in various works as between 2.7% and 18.5%[9,10,11]. On the other hand, this technique has some disadvantages especially in high myopic eyes due to excess use of (OVDs). The incomplete removal of an OVD at the end of such surgery may cause some problems. Numerous reports demonstrate that an (OVDs) left in the eye after cataract surgery is likely to cause a postoperative intraocular pressure (IOP) spike [12, 13]. An early form of postoperative capsular block syndrome may occur due to incomplete removal of (OVDs) [14, 15]. Another disadvantage is the relatively higher price of OVDs, and consequently some surgeons implant IOLs without OVDs. In order to maintain the anterior chamber during IOL implantation, one option is to use an anterior chamber maintainer [16, 17] but it is necessary to create an additional side port for the introduction of the maintainer.

Currently, owing to phacoemulsification and the implantation of foldable IOLs, a very small and self-sealing surgical wound is required. The corneal wound is good sealed so the anterior chamber is considered closed system. There is no leakage of fluid from the anterior chamber and no collapse of the anterior chamber or prolapse of the iris. These facts probably reduce the importance of using an OVD during an IOL implantation. Various techniques have been described to implant IOLs without an OVD, such as by using an anterior chamber maintainer, or by hydro implantation [18]. Hydro implantation is a simple technique that can be easily adopted by every surgeon and for any single-piece foldable IOL. This relatively often used technique, called hydro implantation, was first described by Tak [19]. The irrigation cannula of the bimanual irrigation/ aspiration device is introduced into the eye through the left paracentesis (right if the surgeon is left-handed). This is important not only for eye stability and positioning but also keeps the anterior chamber and capsular bag well distended for the IOL insertion. During the IOL implantation, Tak described continuous irrigation mode but foot pedal–controlled infusion was also described.

2. Aim/Objectives

Our study aims to compare the safety of a single-piece, foldable intraocular lens (IOL) hydro implantation with that of a standard implantation using an ophthalmic visco surgical device (OVD) on central endothelial cell density.

Ophthalmic Viscosurgical Devices (OVDs)

Decades ago, cataract surgery was performed with the aid of an air bubble to keep the anterior chamber formed during the capsulotomy and even lens insertion. The air bubble did very little to protect the corneal endothelium, and its ability to partition or pressurize the eye was marginal. This is part of the reason why surgical complications, from ruptured capsules to corneal decompensation, were prevalent. This changed with the advent of viscoelastics, now more commonly referred to as ophthalmic viscosurgical devices [20].

OVDs were Firstly used in ophthalmic surgery in 1972 as a replacement for vitreous and aqueous humor. OVDs have revolutionized the way of cataract surgery so that the term viscosurgery was used to describe surgical procedures using OVDs**.** OVDs are routinely used in cataract surgery to protect ocular structures especially the corneal endothelium, pressurize the anterior chamber, and provide a faster and safer surgery with better visual recovery .The first commercially available OVD, Healon, changed cataract surgery for the better and started a new class of surgical products. [21]

To use OVDs appropriately, understanding their properties is needed to allow surgeons to choose between the many different commercially available OVDs for different surgical tasks. [22]

Composition and Properties

The commonly used OVDs are composed of the following three building blocks:

- Sodium hyaluronate (NaHA): A biopolymer found in connective tissues including the aqueous and vitreous humors;
- Chondroitin sulfate (CS): Another biopolymer, a major mucopolysaccharide in the cornea; and
- Hydroxypropyl methycellulose (HPMC): A component of plant fibers.

The properties of viscolastics determine the classification, behavior and utility of each OVD. These include viscoelasticity, viscosity, Psuedoplasticity and surface tension. These are useful to understand when making the right choice for use in ophthalmic surgery. [23]

- **Viscosity** describes the resistance to flow. OVDs have flow properties not described by a single value of viscosity, which makes them distinct from other solutions like water.

Zero flow, or zero shear rates, gives the maximum viscosity of a viscoleastic that determines the material's stabilizing effect. Medium viscosity occurs at medium flow of fluid that describes the mobilizing effects of OVDs.

- **Viscoelasticity** describes the elastic component of the solution ability to return to its original shape after being stressed. It describes the material's ability to reform after an external force is applied to the anterior chamber and then removed.
- **Psuedoplasticity** refers to the ease of ability of a material to change from being highly viscous at rest to being watery at higher shear rates.
- **Surface tension, or coatability** of an OVD, describes the surface tension of the OVD itself and also to the contact tissue, surgical instrument or IOL. [23]

Classification

Cohesiveness and depressiveness are useful constructs in describing the clinical behavior of OVDs. They help us to better understand the interaction among the various rheological properties described above. Cohesive OVDs are characterized as being materials with high viscosity, adhere to themselves well by intramolecular interactions, and therefore resist being split apart. These are the higher molecular weight OVDs, which tend to be long chains that are stuck together so they exhibit a high degree of Psuedoplasticity and higher surface tensions. Dispersive OVDs exhibit the opposite characteristics since they have a lower viscosity and a higher coatability, which is the ability to stick to and coat tissues, IOLs and instruments. These have small chains and lower molecular weights that allow them to break apart easily, with lower surface tension and lower psuedoplasticity [24].

To simplify our words, it is easy to divide viscoelastics into four broad categories:

1) Dispersives.
2) Cohesives.
3) Combination agents.
4) Visco-adaptives.

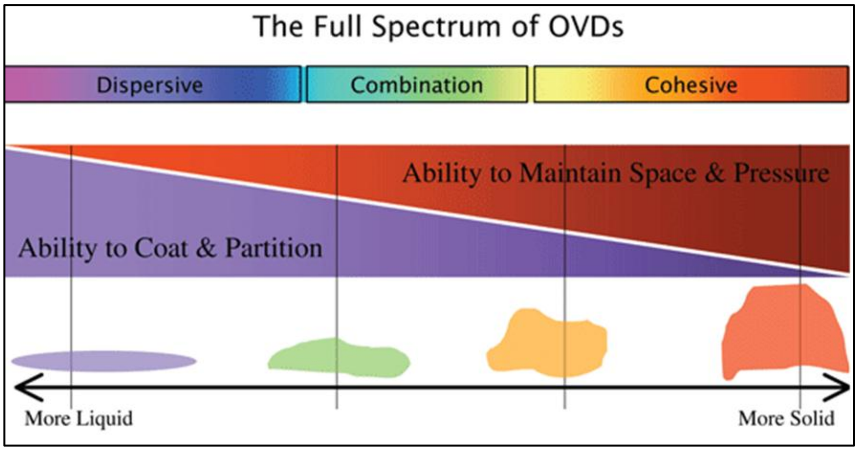

Fig. (1): Ophthalmic viscosurgical devices can be described according to the consistency spectrum, from dispersive to cohesive. Dispersive OVDs have a better ability to coat and partition, while cohesive OVDs have a better ability to maintain space and pressurize. Combination products aim to address both ends of the spectrum.