

## Phacoemulsification of Hard Nuclei on a Single-Piece Foldable Acrylic Intraocular Lens

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### Abstract

**Objectives:** We describe a technique for phacoemulsification of hard (brunescant and white) cataract after implantation of a foldable acrylic posterior chamber IOL (PCIOL) between the hard nucleus and the posterior capsule. This new technique was compared with the standard phacoemulsification.

**Methods:** Interventional randomized case series of 64 eyes of 56 patients with senile mature white or hard brunescant cataract. The first 32 eyes were randomized for standard phacoemulsification using stop and chop technique and one-piece foldable acrylic PCIOL (soft haptics). The second 32 eyes were randomized for the same type of PCIOL implanted between the hard nucleus and the posterior capsule before starting phacoemulsification "the implant pre-phaco" group.

**Results:** In each group 2 eyes developed transient corneal edema. Iris phaco-burn developed in 2 eyes of the standard phacoemulsification group and one eye of the "implant pre-phaco" group. Posterior capsule rupture (PCR) with vitreous prolapse occurred in 3 eyes of the standard phacoemulsification group. In the "implant pre-phaco" group one eye developed PCR with no vitreous prolapse. The difference in PCR between the 2 groups was not statistically significant but the vitreous prolapse in the AC was significantly higher in the standard phacoemulsification group. IOL decentration or dropped lens fragments did not occur in either group.

**Conclusion:** The IOL behind the hard nucleus acts as barrier shield that covers and protects the posterior capsule and the anterior vitreous face. This could make phacoemulsification of hard cataracts safer.

**Keywords:** Implant pre-phaco; Hard nuclei; Mature white; Brunescant cataract acrylic single piece IOL; Posterior capsule rupture (PCR); Phacoemulsification after implantation

### Introduction

A cataract becomes mature when it becomes so opaque that the red fundus reflex is absent. The lens may look white or brunescant. Surgical removal of mature cataracts presents many challenges. The capsule is more fragile, leakage of liquefied cortical material and the absence of red reflex obscure visualization, and capsulorhexis tends to extend to periphery because of high intracapsular pressure. Moreover, hard intumescent and brunescant lenses are at increased risk of complications related to posterior capsule rupture (PCR) such as vitreous prolapse into the anterior chamber (AC) and the wound, dropped nucleus or fragments, IOL drop, decentration and vitreous traction on the retina. Apart from more prolonged phacoemulsification time and manipulation of a large and hard nucleus, the posterior capsule is often thinned and stretched by the expanded intumescent lens. As a result, posterior capsule is prone to be ruptured during phacoemulsification particularly during nuclear fragment emulsification stage. Also, the epinucleus that protects the posterior capsule is almost absent [1-6].

To our knowledge, this is the first article that describes a technique for phacoemulsification of hard nuclei after implantation of a foldable acrylic PC IOL underneath to protect the posterior capsule during phacoemulsification of such nuclei.

### Methods

This study included 64 eyes with senile mature intumescent or brunescant cataract classified by using the lens opacities classification system LOCS III as nuclear 4-5 and cortical 5 [1]. Eyes with AC depth below 3 mm or axial length <21 mm were excluded from this study to avoid corneal endothelial injury. Eyes with hypermature cataract (wrinkled capsule with calcification), pseudo-exfoliation, subluxated lenses or zonular dehiscence were excluded. Complicated cataract to uveitis, trauma, glaucoma, retinal detachment, vitrectomized or silicone filled eyes were also excluded. Institutional Review Board (IRB)/Ethics Committee approval was obtained. The study adhered to the tenets of the Declaration of Helsinki. Peribulbar anesthesia was used. Superior clear corneal 2.4 mm was created. After the AC was filled with air, the anterior capsule was stained with trypan blue 0.1%. AC was filled with an ophthalmic viscosurgical device (OVD): Viscoat (3% sodium hyaluronate, 4% chondroitin sulfate; Alcon Laboratories, Inc) or DisCoVisc (4% sodium chondroitin sulfate, 1.65% sodium

hyaluronate; Alcon Laboratories, Inc.). A wide 7.0 mm capsulorhexis was performed using a cystitome through a paracentesis side port.

Cases were randomized chronologically. The 1<sup>st</sup> 32 eyes underwent standard phacoemulsification in the bag using stop and chop technique then were implanted with a single-piece foldable acrylic IOL with soft haptics (6.0 mm optic, 12.50-13 mm overall length) after filling the bag with OVD. In the next 32 eyes “the implant pre-phaco” group, the equatorial edge of the nucleus was delivered outside the capsular bag and the whole nucleus was tumbled outside the bag to supra-capsular level at the main incision using sinsky hook and the bag underneath was filled with OVD. A single-piece acrylic IOL with soft haptics was loaded into the cartridge and injected under the superior edge of the nucleus directly into the capsular bag. The IOL was unfolded under the nucleus. The trailing haptic was dialed under the iris. The stop and chop technique was used to complete phacoemulsification below the pupillary plane. In 3 cases, sculpting up to nucleus division was done to reduce the bulk of the nucleus before IOL implantation and in 4 eyes the IOL was implanted under already divided nuclear quadrants. The cortex was cleaned using the double way cannula or the automatic irrigation/aspiration system. Air was injected into the AC at the end of surgery (Supplementary file 1).

## Results

Thirty-four patients were females and 22 were males. The ages ranged from 52 to 81 y and the average age was 64.5 y. The standard phacoemulsification group included 32 eyes of 27 patients. Two eyes in this group had iris phaco-burn, 3 eyes developed PCR with vitreous with 3-piece foldable acrylic IOLs over the anterior capsular rim. The next 32 eyes of 29 patients underwent phacoemulsification over single-piece foldable acrylic IOL. After phacoemulsification was completed, the underlying IOL was found in the bag or sulcus-bag in 12 eyes, totally sulcus in 7 eyes, sulcus-AC in 13 eyes. Even primary bag implanted IOLs were moved aside to complete irrigation aspiration of residual cortex underneath. Outside the bag IOLs were redialed into the bag. One eye in the “the implant pre-phaco” group had iris phaco-burn another eye developed PCR due to extension of wide capsulorhexis without vitreous prolapse and the IOL was left in the sulcus. In both groups, two eyes developed significant corneal edema with moderate striate keratopathy that resolved within 1 week using hypertonic saline and topical steroids. Dropped lens or fragments did not occur in either groups and IOLs were well centered all through the follow up period up to 9 months.

## Discussion

Due to its complications, PCR during phacoemulsification is the nightmare of many cataract surgeons especially the beginners. It occurs in 2% to 4% of cases. A person with a brunescence/white cataract would have an approximately threefold increased risk of PCR and its complications compared with someone who did not have such a cataract. Other risk indicators for PCR are increasing age, male gender, glaucoma, diabetic retinopathy, no fundal view/vitreous opacities, pseudoexfoliation/phacodonesis, small pupil, axial length  $\geq$  26.0 mm, the use of the  $\alpha$ -blocker doxazosin, inability to lie flat and trainee surgeons performing operations [7,8].

The standard phacoemulsification group had higher incidence of PCR (9.4%) than the “implant pre-phaco” group (3.1%). However, the difference was not statistically significant. ( $P=0.306$ , Chi-squared test for the comparison of two proportions from independent samples).

The standard phacoemulsification group developed vitreous prolapse in the 3 eyes with PCR (9.4%) because the hot highly vibrating phaco-tip ruptured the posterior capsule and the anterior vitreous face while the high vacuum pulled the vitreous into the AC. The “implant pre-phaco” group did not develop vitreous prolapse in the eye that had PCR and the anterior vitreous face remained intact. This could be explained by the presence of PCIOL between the anterior vitreous face and the phaco-tip. The difference in vitreous loss between the 2 groups was statistically significant ( $P=0.0784$ ).

We preferred dispersive OVDs containing chondroitin sulfate due to superior coating along the endothelial layer than cohesive OVDs. Chondroitin sulfate, which is negatively charged, binds to the endothelium, which is positively charged. Hence dispersive OVDs provide greater protection for the endothelium [9,10].

Foldable IOLs with soft haptics were used instead of hard proline haptics to avoid PCR during IOL unfolding under the hard nucleus.

Phacoemulsification was almost done below the pupillary plane to avoid excessive manipulations in the AC, corneal endothelial injury and iris phaco-burn. The phaco-tip touched the PCIOL in almost all eyes with few scratches on the IOL surface.

The presence of PCIOL during irrigation aspiration of the cortex provides a barrier that protects the cornea from the fluid turbulence in the posterior chamber and maintains full capsular bag. Moreover, the mature cataract has the advantage of scanty cortical matter. One disadvantage of this study was the lack of specular microscopy to detect endothelial count and condition. However, postoperative corneal clarity was used as clinical indicator.

## Conclusion

Hard cataract imposes heavy stress on many ophthalmic surgeons. Implantation of a single-piece foldable acrylic IOL between a hard nucleus and the posterior capsule provided a barrier that protected the posterior capsule from the high, prolonged phaco-power required to emulsify the hard nucleus. This could make phacoemulsification of hard cataracts safer and gives the surgeon more confidence and relaxation during such operations.

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