Surgical Technique

A multipronged approach to prevent Argentinian flag sign in intumescent cataracts

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In this communication, we describe a technique for creation of a single stage, adequately sized capsulorrhexis in intumescent cataracts by depressurizing the anterior and posterior intralenticular compartments in a nonleaky anterior chamber (AC) to prevent capsulorrhexis extension and Argentina flag sign. Initially, an incomplete main-port incision is made by the partial entry of a 2.2-mm keratome. A cohesive dispersive ophthalmic viscosurgical device (OVD) is injected into AC. Standard side-port incisions are made, followed by anterior capsular staining. The fluid cortex in anterior intralenticular compartment is aspirated by puncturing anterior capsule in the center using a 30-gauge needle entered through a separate limbal stab incision. The nucleus edge is gently tipped posteriorly with the needle tip to release the fluid from posterior intralenticular compartment also and as much fluid aspirated as possible. OVD is again injected and capsulorrhexis is performed in a single stage using micro-capsulorrhexis forceps.

Key words: 30-gauge needle, Argentina flag sign, capsulorrhexis extension, intralenticular pressure, intumescent cataract, white cataract

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Managing a case of white cataract is a surgical challenge due to multiple factors including difficulty in creating an intact capsulorrhexis, inability to assess nuclear hardness preoperatively because of the opaque cortex, a weak and flaccid posterior capsule, and/or absence of the epinucleus.[1] Achieving an intact capsulorrhexis is a key step for the safe and successful phacoemulsification. There is a high risk of radial extension of capsulorrhexis and Argentina flag sign in intumescent cataracts.[2,3] Several techniques have been described for a safer and more predictable capsulorrhexis creation in these cases including the use of trypan blue dye, enhancement of anterior capsular visualization using an endoilluminator, two-stage capsulorrhexis, aspiration of the fluid cortex using a 30-gauge needle, creation of capsulorrhexis using micro-capsulorrhexis forceps through a single side-port incision of 0.8 mm under a high-density viscoelastic, or femtosecond laser-assisted capsulotomy.[4-9] Figueiredo *et al*. described the concept of two pressurized intralenticular compartments – anterior and posterior. Even after aspiration of intralenticular fluid from the anterior compartment, capsulorrhexis extension may occur because of increased posterior intralenticular pressure rather than the vitreous pressure which pushes the lens upward.[6] Here, we describe a simple approach using a series of modifications to the steps of standard phacoemulsification, to decrease the anterior and posterior intralenticular pressure, while maintaining a stable, nonleaky anterior chamber (AC) to enable creation of an adequate-sized continuous curvilinear capsulorrhexis (CCC) in a single stage.

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No preoperative hyperosmolar agent is given. Under topical/peribulbar anesthesia and aseptic conditions, an incomplete main-port incision is made with 2.2-mm keratome (Alcon Laboratories, Inc., Fort Worth, TX, USA) which is entered halfway between the tip and a mark made on it. This results in the inner lip of the trapezoidal phaco tunnel to be of a smaller size of approximately 1.2–1.4 mm [Fig. 1a], so as to maintain a nonleaky AC during capsulorrhexis creation. An ophthalmic viscosurgical device (OVD) DisCoVisc (Alcon Laboratories, Inc., Fort Worth, TX, USA) containing 1.6% hyaluronic acid and 4.0% chondroitin sulfate is injected into AC. Two standard side ports of 1.2-mm size are made in a usual manner. Anterior capsule of the lens is stained with trypan blue dye 0.03% (50% dilution of 0.06% dye) (Auroblue, Aurolabs, India) under OVD using painting technique [Fig. 1b].[10] After capsular staining, OVD DisCoVisc is injected again to replace the dye-stained viscoelastic for enhanced visibility as well as to flatten the anterior capsule of the lens [Fig. 1c]. Following this, a 1-cc insulin syringe with 30-gauge needle of 8-mm length is bent near the hub, with the bevel facing down, and

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is entered into AC through a separate limbal stab incision. Anterior capsule is punctured in the center to aspirate the liquefied cortex and decompress the anterior intralenticular compartment. A 1-cc syringe entered through a separate limbal stab incision rather than a side-port incision helps in decreasing the viscoelastic loss from AC and prevents sudden extension of capsulotomy. This is followed by tipping the edge of the nucleus posteriorly with the needle tip so that the fluid trapped between the posterior surface of the nucleus and anterior surface of the posterior capsule flows anteriorly, resulting in decompression of the posterior intralenticular compartment as well. Tapping of the nucleus is done gently in the mid-periphery to break the equatorial barrier which is formed in intumescent cataracts because of the compression of capsule at equatorial edge by the nucleus which prevents posterior intralenticular fluid to come out of the capsular bag and can push the lens forward and cause extension of capsulorrhexis even after depressurization of the anterior intralenticular compartment as described by Figueiredo *et al*.[6] By breaking the equatorial barrier, posterior capsule blowout is also prevented. As much fluid as possible is then aspirated [Fig. 2a]. OVD is injected again to compensate for the loss of intralenticular volume and to flatten the anterior capsule into a flat/scaphoid configuration to prevent runaway capsulorrhexis. A 5–5.5-mm CCC is then completed in a single stage using micro-capsulorrhexis forceps under Callisto guidance (Carl Zeiss Meditec AG, Jena, Germany) [Fig. 2b]. The main incision is then entered fully with the 2.2-mm keratome, and phacoemulsification is completed in a usual manner. Fig. 2c shows the circular capsulorrhexis of adequate size visible against the fundal glow after nucleotomy and cortical matter removal. The technique is illustrated in the accompanying video.

Discussion

Creating an intact capsulorrhexis in intumescent cataracts is a challenging task because of high intralenticular pressure and poor visibility due to the absence of red reflex which can be compounded by the leakage of cortex. The incidence of incomplete capsulorrhexis associated with white cataract surgery has been reported to vary from 3.85% to 28.3%.[2,3] While femtosecond laser-assisted capsulotomies are a new tool available in the armamentarium of modern-day cataract surgeon, they have been associated with microadhesions and incomplete capsulotomies in up to 47.5% cases of intumescent cataracts, especially if associated with leakage of intralenticular fluid.[9] In less developed countries where the incidence of hypermature cataracts is fairly high and access to expensive femtosecond laser technology limited, techniques for safer creation of manual CCCs play an important role in ensuring optimal outcomes.

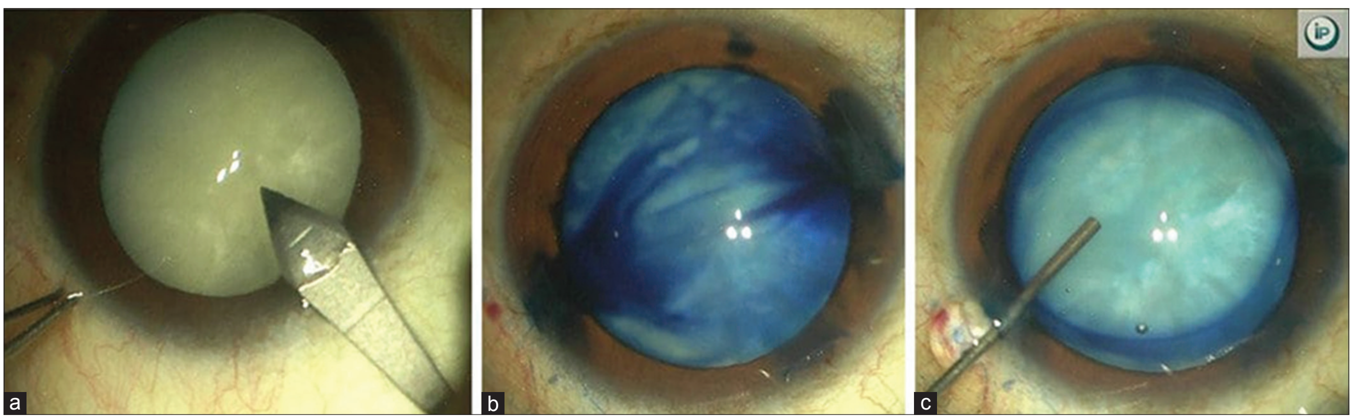

Figure 1: (a) Main-port incision is made using 2.2-mm keratome with its partial entry into anterior chamber up to halfway between the tip and the mark. (b) Anterior capsule is stained with trypan blue dye using painting technique. (c) Viscoelastic is injected again after capsular staining

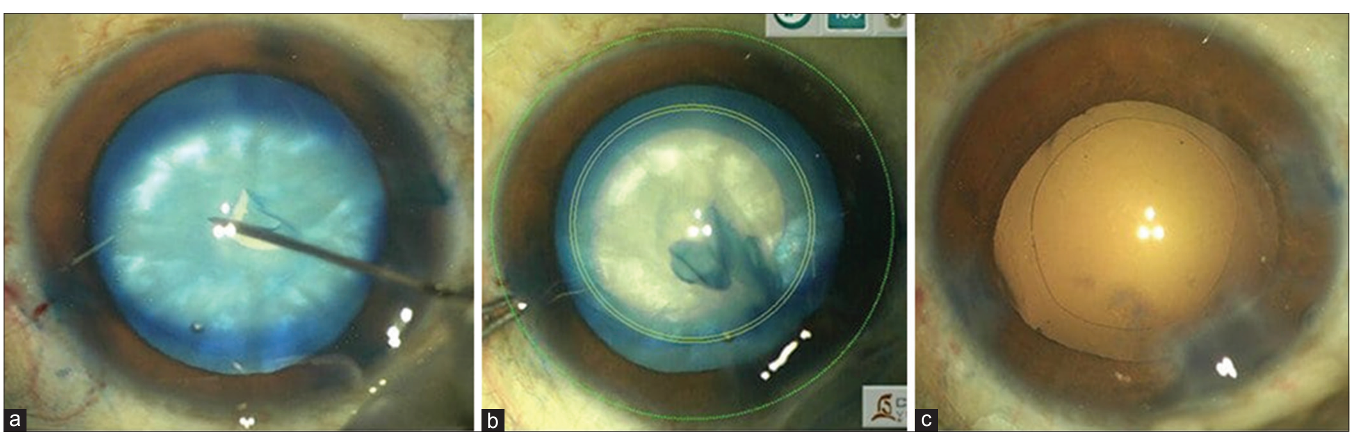

Figure 2: (a) A 1-cc insulin syringe with 30-gauge needle entered in anterior chamber with bevel facing down and the anterior capsule is punctured in the center to aspirate lenticular fluid. (b) A Callisto-guided circular capsulorrhexis is completed with adequate size in a single stage. (c) Capsulorrhexis of adequate size visible after cataract removal

Many techniques have been described to decrease the high chances of radial tears and Argentina flag sign during creation of a manual CCC. Aspiration of fluid cortex with a 30-gauge needle is one such maneuver which helps to decrease the intralenticular pressure and prevents the peripheral extension of CCC. Variations of this technique have been described in the literature with most of them describing capsulorrhexis completion as a two-stage procedure.[1,2,6] None of these techniques have, however, described the concept of posterior intralenticular compartment and its decompression. Figueiredo *et al*. put forth the concept of two pressurized intralenticular compartments – anterior and posterior – and postulated that it is the posterior intralenticular pressure between the nucleus and posterior capsule of the lens, rather than the vitreous pressure, which pushes the nucleus upward and can lead to capsulorrhexis extension even after the use of preoperative mannitol or aspiration of intralenticular fluid from the anterior compartment.[6] They described the Brazilian technique where after aspirating the fluid cortex from the anterior intralenticular compartment with a needle, a mini-capsulorrhexis of approximately 3 mm in size is created, followed by repeat aspiration of the fluid trapped within posterior intralenticular compartment using bimanual irrigation/aspiration cannulas. The mini-capsulorrhexis is then enlarged to the desired size in the second stage.

Another maneuver commonly advocated to prevent capsulorrhexis extension in intumescent cataracts is to maintain the AC pressure higher than lenticular pressure by preventing viscoelastic loss from incisions and/or use of high-density viscoelastic. Robinson and Olson described a capsulorrhexis technique in hypermature cataracts wherein a single side-port incision of 0.8 mm is made, the anterior capsule stained under fluid or air, and AC pressurized with sodium hyaluronate 1.4% (Healon GV) or 2.3% (Healon 5), followed by creation of a single-stage capsulorrhexis with 23/25-gauge micro-capsulorrhexis forceps which snugly fits the incision and hence prevents viscoelastic leak.[8]

In the authors' experience, the technique described in the present communication has certain advantages over those described by Figueiredo *et al*. and Robinson and Olson.[6,8] As compared to the Brazilian technique, where peripheral extension of the edge of the mini-capsulorrhexis may occur inadvertently at the time of insertion and removal of the irrigation/aspiration cannulas into the small-sized anterior capsular opening, the surgical approach described by us has the advantage of simultaneous decompression of the anterior and posterior intralenticular compartments using the 30-gauge needle of an insulin syringe, without the need for repeated entry of the instruments into the AC and the anterior capsular opening.[6] In addition, the circular capsulorrhexis of adequate size is created in a single stage, ensuring better control and reducing the surgical time. Creation of the capsulorrhexis through a single side-port incision as advocated by Robinson and Olson may be technically challenging and associated with a learning curve, especially for surgeons used to performing capsulorrhexis from the main-port incision in routine cases.[8] The initial partial entry with 2.2-mm keratome at the site of the main incision as performed in our technique allows for easy manipulation of the capsulorrhexis through the main-port without increased risk of viscoelastic loss.

The combinations of surgical steps described in the present technique are all aimed at reducing the uncertainties associated with the outcomes of intumescent cataracts. DisCoVisc coats and protects the endothelium. Staining of the anterior capsule under viscoelastic keeps the AC stable with decreased trampolining and reduced risk of pupillary miosis while also preventing contact of the trypan blue dye with the endothelium and the possible endothelial toxicity.[10]

Conclusion

In the authors' experience, the technique for managing intumescent cataracts as described by us has the advantage of familiarity of the steps of standard phacoemulsification, while ensuring enhanced safety and consequently better surgical outcomes.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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