

Use of Narrow Calibrated Side-Port Technique to Prevent Occurrence of Intraoperative Floppy Iris Syndrome During Phacoemulsification Surgery

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Purpose: To describe the use of a narrow calibrated side-port incision technique in preventing Intraoperative Floppy Iris Syndrome (IFIS).

Setting: Dr Om Parkash Eye Institute, Amritsar, India.

Design: Prospective interventional study.

Methods: Four hundred and fifty eyes of patients using alpha-1 antagonist drug Tamsulosin were included in the study. Phacoemulsification surgery was performed with a calibrated side-port incision integrated to the existing preferred techniques in patients taking Tamsulosin. Our technique involved creating a narrow 500 microns (μm) side-port incision, paired with a differentially calibrated chopper shaft measuring 400 to 450 μm , with a 50 μm variation along the shaft. This precise calibration between the side-port and chopper sizes minimized fluid leakage, preventing surgical impediments and side-port wound distortion. The reduced fluid efflux through the side-port incision stabilized the anterior chamber near the side port, decreased iris contact with the chopper and eliminated the risk of iris prolapse. Integration of side-port calibration into the existing techniques helped prevent IFIS from developing around the side-port incision site.

Results: Our technique of calibrated side-port incision, which requires perfect calibration of the incision with the chopper, gave excellent results. Our study comprised of a total of 450 eyes from patients on Tamsulosin undergoing phacoemulsification were included. IFIS was completely absent in 271 eyes. Minimal IFIS, characterized by iris billowing, was observed in 179 eyes, while no cases of moderate or severe IFIS occurred.

Conclusion: When added to existing surgical techniques, a calibrated side-port incision significantly improves patient outcomes in managing IFIS during phacoemulsification in patients taking alpha-1 antagonist drugs. This modification helps prevent the side-port incision from becoming a focal point for IFIS, thereby enhancing surgical safety and efficacy.

Keywords: intraoperative floppy iris syndrome, phacoemulsification, cataract surgery, incisions, surgical, intraoperative complications

Introduction

IFIS is one of the significant intraoperative challenges in patients on alpha-1 antagonist drugs.^{1,2} In patients predisposed to IFIS, there is weak iris dilator muscle tone, which eventually becomes thinned and atrophic, leading to a poorly dilating pupil.³ The reduced tone of the iris dilator muscle makes the iris more susceptible to undulation and billowing in response to intraoperative fluidics. Subsequently, IFIS can manifest as iris billowing, progressive pupillary constriction, and iris prolapsing through the incisions. The incidence of IFIS in these patients on alpha-1 antagonist drugs ranges from 12.3% to 83.3%.⁴

Various preoperative and intraoperative measures are implemented to prevent and manage IFIS. Despite these measures, complications such as intraoperative iris billowing, progressive pupillary constriction, iris prolapse, posterior capsule rupture, posterior dislocation of nuclear fragments, and difficulty in intraocular lens implantation still occur. Postoperatively, these patients exhibit a range of iris defects and compromised visual outcomes.^{5,6}

We describe a technique that involves adding a modality for narrowing and calibrating the side-port as an adjuvant to commonly used modalities to prevent the occurrence of IFIS.

Surgical Technique

The study adhered to the Declaration of Helsinki. Approval was obtained from the Dr Om Parkash Ethical Committee, and informed consent was obtained from all patients.

Inclusion criteria: All cataract patients undergoing phacoemulsification and using Tamsulosin for more than 6 months. No patient was asked to discontinue Tamsulosin prior to surgery.

Exclusion criteria: Patients with a maximum pupillary diameter size of less than 5.0 mm, patients with associated corneal opacities, corneal endothelial cell disease, Pseudoexfoliation Syndrome, zonular dysfunction, Glaucoma, anterior uveitis, iris neovascularisation, history of ocular injury and surgery were excluded from the study.

The side-port calibration technique was employed in 450 eyes of 344 patients on Tamsulosin between January 2018 and October 2024. In every patient, pupil was dilated before the surgery with mydriatics (tropicamide 0.8%, phenylephrine hydrochloride 5% eye drops) Also, topical diclofenac sodium 0.1% eye drops were instilled in every case to retain the maximum pupillary diameter during surgery.

Surgeries were performed by two surgeons (ROP, TOP, SM) using 0.5% proparacaine hydrochloride as topical anaesthetic agent in 450 eyes of 344 patients. A 2.4 mm wide square and long tunnel was placed slightly anteriorly to provide stable anterior chamber and decrease predisposition of iris to prolapse. Intra-cameral epinephrine was used to provide additional dilatation of pupil. A 25 G needle with an outer diameter of 500 μm was used to make a side-port incision for the chopper, whose shaft had a diameter of 400–450 μm from the distal to the proximal part (Figure 1a and b). This provided adequate synching in the diameter of the side-port made by a 25 g needle without causing any wound distortion during manipulation of the chopper in the anterior chamber.

After performing anterior capsulorhexis using a capsulorhexis forceps, a gentle hydrodissection was performed after burping of the OVD from the anterior chamber.

Low fluidics (IOP settings of 20 mm Hg to 40 mm Hg) and a Stop and chop technique was used in all the cases. Following the creation of a trench, the nucleus was divided across the pupillary extent to divide the nucleus into two halves. Nuclear fragments were chopped into small nuclear fragments, totally separated from one another and left in-situ. The firmly held nuclear fragments were brought anteriorly into the plane of anterior capsule and emulsified in the centre near the proximal half of the pupil to avoid inadvertent emulsification of iris and decrease HPMC aspiration. The phaco

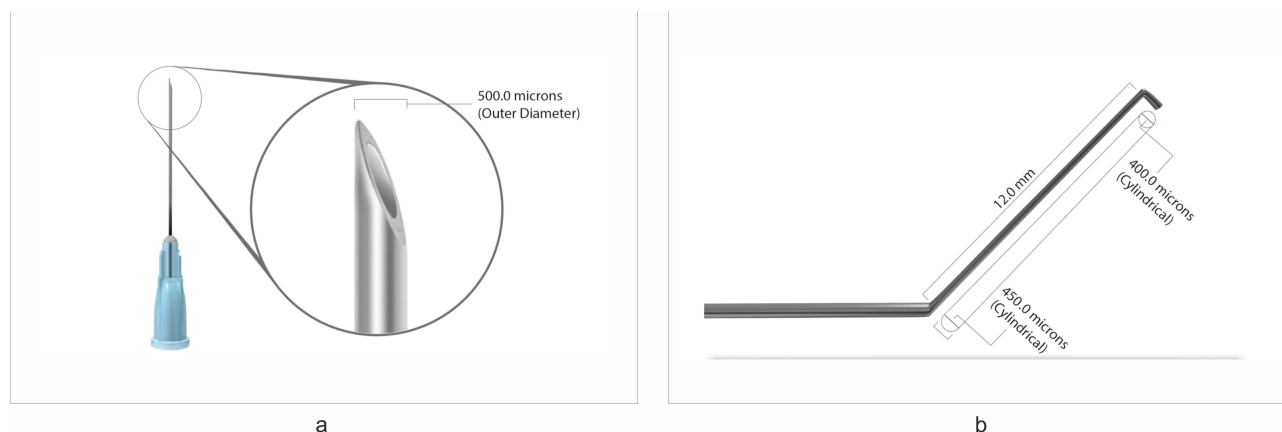


Figure 1 (a) 25 G needle used for side port incision with outer diameter of 500 μm . (b) Chopper with a shaft diameter varying between 400 and 450 μm . The differential calibration of the side-port incision with the chopper along its shaft length facilitates surgical manipulations without distorting the side-port wound.

tip and the irrigation and aspiration (IA) tips were set to irrigation-off mode before insertion and removal from the anterior chamber. During irrigation and aspiration, high sleeve retraction of the IA tip created two planes of irrigation and aspiration.

Subsequently, a single piece Intra Ocular Lens was implanted followed by removal of OVD and wounds hydration.

Pupillary size was measured at the start of surgery and at completion of surgery with callipers. Intra-operative iris billowing, pupillary size, and iris prolapse through the incisions were observed.

IFIS grading was done from 0 to 3 as follows:

1. Grade 0 - No IFIS
2. Grade 1 - Iris billowing
3. Grade 2 - Iris billowing, pupil size change of more than 2.0 mm,
4. Grade 3 - Iris billowing, pupil size change of more than 2.0 mm, iris prolapsing into the incisions

Results

Of the 450 eyes, an IFIS Grade 0 was recorded in 271 eyes, while 179 eyes had an IFIS Grade 1. No patients experienced IFIS Grade 2 or Grade 3.

Surgery was successfully performed in all patients, with no other intraoperative complications.

Discussion

Intraoperative Floppy Iris Syndrome, first described by Chang et al, is a complication that occurs during phacoemulsification in patients taking alpha-1 antagonist drugs.¹ Tamsulosin, an irreversible alpha-1 antagonist, has the highest propensity to cause IFIS due to its strong specificity for blocking alpha-1 adrenergic receptors in the iris.

However, Goyal et al reported a high incidence of IFIS in Indian patients, who predominantly have darker irises, and demonstrated that iris colour does not significantly predispose individuals to IFIS.⁷

The iris of a patient using alpha-1 antagonist drugs differs from a normal iris. First, iris trauma in patients on alpha-1 antagonists causes an exaggerated pupillary constriction response due to decreased tone and function of the dilator muscle. Second, there is an increased propensity for iris undulation and billowing when fluid is directed towards the posterior aspect of the iris, predisposing it to iris touch, progressive pupillary constriction, and iris prolapse through the incisions.

As a result, trauma to the iris leads to relatively unopposed pupillary constriction and the progression of IFIS.

IFIS is characterized by a triad of features caused by reduced tone of the iris dilator muscles and a smaller pupil size. The triad includes iris undulation and billowing in response to fluid dynamics within the anterior chamber, progressive pupillary constriction during surgery, and a tendency for the iris to prolapse through surgical incisions.

Strategies to reduce IFIS include appropriate pharmacologic dilatation using atropine sulphate, tropicamide or cyclopentolate combined with phenylephrine hydrochloride, along with allowing sufficient time for the pupil to dilate.⁸ Non-steroidal Anti-Inflammatory Drugs (NSAIDs) help maintain intra operative pupillary dilatation. Intracameral injection of epinephrine and ketorolac are used to dilate the pupil.^{9,10} However, with prolonged usage of alfa-1 antagonist drugs, the effectiveness of epinephrine diminishes due to atrophy of the iris dilator muscle.

Casuccio et al identified predisposition to IFIS in patients with a dilated pupil size of less than 7.0 mm.¹¹ Pupillary dilating devices are often used to maintain pupil dilatation.¹² Chang et al demonstrated that the Malyugin ring provides consistent pupillary dilatation and reduces complications.¹³ However, patients still experience severe IFIS, with iris prolapsing through the incisions.

Most surgeons create a tight phaco wound with a square, long tunnel positioned slightly anteriorly to achieve a stable anterior chamber and decrease the predisposition to iris prolapse.¹⁴ OVD has also been used to achieve viscomydriasis and deepen the anterior chamber, particularly in the subincisional part. Arshinoff described the Trisoft shell technique, wherein low-viscosity viscodispersible OVD helps flatten the iris and reduce propensity of iris flopping, while high viscosity OVD further aids in pupil dilatation.¹⁵ Viscoelastic shell stretching from pupillary plane to the corneal surface

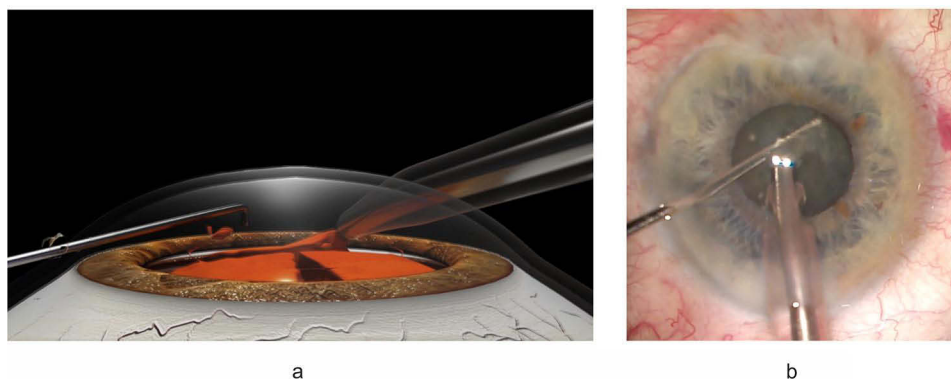


Figure 2 (a) 3D illustration of a side-port incision calibrated with the chopper. The chamber remains stable, with minimal fluid efflux from the incision, no iris contact near it, and no nuclear fragments attracted toward the side-port incision. (b) Calibrated side-port incision with stable chamber settings and no iris contact.

decreases predisposition to IFIS. Other steps to reduce chances of occurrence of IFIS include gentle hydrodissection or modified hydrodissection after burping of OVD from the anterior chamber.^{16,17}

Some surgeons create a capsulorhexis smaller than the intraoperative size of pupil as the anterior capsule rim beneath the pupil can restrict fluid access to the posterior aspect of thinned, atonic posterior dilator muscle region, reducing the iris billowing caused by the fluidics during nuclear emulsification.¹⁸

Employing slow motion phaco settings for irrigation, aspiration and phaco power, while consistently staying in the middle, promotes stable chamber settings and decreased turbulence in the anterior chamber.¹⁹

To minimize the risk of iris prolapse during anterior chamber entry or exit, the phaco and I&A tips should remain in irrigation-off mode, and addition of OVD should be avoided. Bimanual I&A or high retraction of the irrigating sleeve in coaxial I&A helps direct the irrigating fluid toward the anterior surface of the iris, thereby preventing iris prolapse.²⁰

However, despite all these measures, IFIS can still occur due to fluid leakage through the side-port incision that often goes unnoticed and can adversely affect the stability of anterior chamber.^{21,22}

Prakash et al demonstrated that calibrating the narrow side-port incision controlled fluid efflux through it. The calibrated incision minimized fluid loss and maintained anterior chamber stability, preventing complications seen with non-calibrated incisions. Consistent chamber stability around the side-port incision helped maintain pupillary diameter by decreasing iris billowing and reducing iris trauma.²³

Richard Packard was the first to describe the use of a 20 G side-port incision with the “Fat Boy” chopper in patients predisposed to IFIS.²⁴ The chopper’s shaft more or less matches the size of the incision, minimizing fluid leakage. However, when using this innovative chopper, there is still a risk of sudden fluid efflux through the side-port incision when the thinned or tapered part of the chopper shaft moves near the incision, causing a mismatch between the incision and chopper shaft.

Our technique employs a calibrated side-port approach to prevent the occurrence of IFIS through the side port. This involves creating a narrow 500 μm side-port incision using a 25 G needle or an appropriately sized, ultra-sharp side-port knife or MVR blade, along with a differentially calibrated narrow chopper with a shaft diameter of 400 to 450 μm , with a gradual 50 μm variation along its length. The close matching of the side-port incision and chopper shaft sizes minimizes fluid leakage without impeding surgical manipulation or causing side-port wound distortion.

The advantage of our technique, which uses a narrow side-port incision with precise calibration to the chopper, is that it limits fluid efflux. This ensures a stable chamber setting around the side-port incision, resulting in minimal iris billowing, reduced iris contact with the chopper, and elimination of the risk of iris prolapse (Figure 2a and b).

Another advantage of our technique is that minimal turbulence and controlled fluid efflux reduce the chances of nuclear fragments getting stuck to the sub-incisional part of the side-port incision, thereby decreasing nuclear fragment-related iris trauma and pupillary constriction (Figure 3a and b). Thus, the calibrated side-port approach effectively prevents IFIS from developing at the side-port incision site.

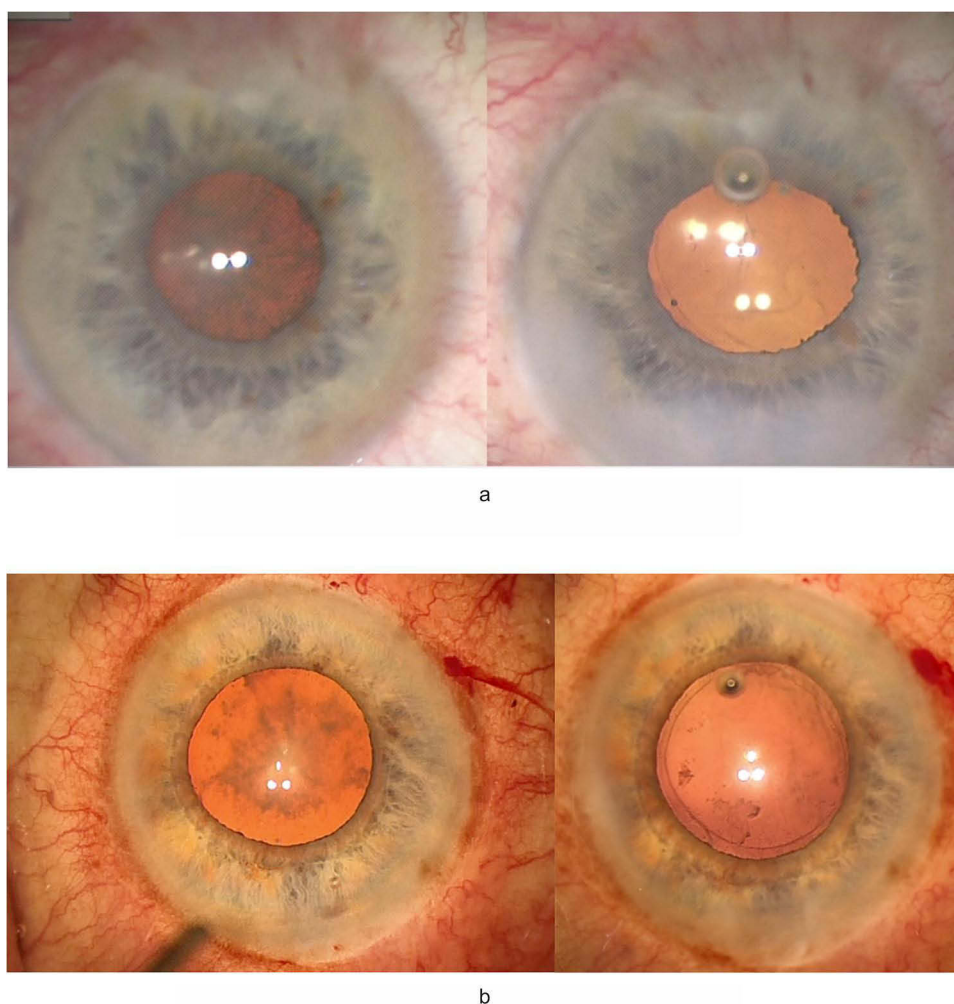


Figure 3 (a) Pupil size remains the same at the start and end of surgery. (b) Pupil size remains the same at the start and end of surgery.

Conclusion

In conclusion, the addition of a calibrated side-port technique to the existing surgical protocols enhances their efficacy in preventing IFIS.

Ethics and Consent Statements

The Ethics Committee of Dr. Om Parkash Eye Institute approved the study before its initiation. The patient's written informed consent was obtained, and the tenets of the Declaration of Helsinki were followed.

Disclosure

The authors report no conflicts of interest in this work.

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