Original Article

Intraoperative aberrometry in cataract surgery with topical versus peribulbar anesthesia

Sudarshan Khokhar, Yogita Gupta, Chirakshi Dhull, Vipul Singh

Purpose: To study the effect of choice of anesthesia on the refractive outcomes of intraoperative aberrometry (IA) for intraocular lens power calculation in cataract surgeries. **Methods:** This prospective, interventional nonrandomized cohort study was conducted at a tertiary care hospital between March and August 2018. A total of 178 patients with age-related cataract were allocated into two groups. Group 1 received peribulbar anesthesia using a mixture of xylocaine 2% + adrenaline 0.125 mg/ml + hyaluronidase 15 IU/ml with a 23G, 32 mm needle, while Group 2 received topical anesthesia with proparacaine hydrochloride 0.05% drops. Intraoperative aphakic measurements and IOL power calculations were obtained in all patients with the optiwave refractive analysis (ORA) system. Analysis was performed to compare the baseline parameters and postoperative manifest refraction at month 1. **Results:** A total of 89 patients were included in group 1 and 89 in group 2. At baseline, the axial lengths (P = 0.66) and mean keratometry (P = 0.91) were comparable. The quality measure of captured wavefront data was comparable (0.25) between the groups. Also, the postoperative mean refractive spherical equivalents were comparable between the two groups (P = 0.98) at one month. **Conclusion:** IA can be utilized well for cataract surgeries performed under local anesthesia with good quality of captured wavefront, provided the eye can be aligned in centre with the fixation light of ORA.

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Cataract surgery, the most commonly performed surgery in ophthalmology worldwide, has now become more of a refractive procedure, with patients' higher expectations for better refractive results and spectacle independence. Intraoperative aberrometry (IA) is now increasingly being used in cataract surgery to obtain more accurate postoperative refractive outcomes. Optiwave refractive analysis (ORA) (ORA™ with VerifEye+™ technology, Alcon, Fort Worth, TX, USA) is an aberrometry system that measures phakic, aphakic and/or pseudophakic refraction at the time of cataract surgery. Using Talbot–Moiré interferometry, it functions by studying the diffraction pattern of the wavefront as it passes through a pair of gratings kept at an angle to each other.[1,2] It enables cataract surgeons to decide intraocular lens (IOL) power[3,4] and guides them in rotating the axis of toric IOLs precisely after studying the residual astigmatism. Its accuracy for IOL power estimation has been established in challenging situations such as eyes with prior LASIK or photorefractive keratectomy.[5]

Local anesthesia is conventionally considered as a limitation to use ORA system as central fixation is considered essential for capturing wavefront aberrometric data. However, there exists a set of patients who cannot be operated under topical anesthesia due to patient factors like: refusal for topical anesthesia, poor cooperation level, inability to fixate the eye intraoperatively, uncorrected hearing impairment causing them not to follow instructions peroperatively, head nodding habit, very anxious patients, etc. No study has been performed to study the feasibility of using IA in patients undergoing cataract surgery under local anesthesia. The goal of this study was, thus, to determine whether ORA can be useful for IOL power estimation in patients operated under peribulbar anesthesia.

Methods

A nonrandomized, prospective and interventional cohort study strictly adhering to the tenets of the Declaration of Helsinki was conducted from March 2018 to July 2018. A written, informed consent was obtained from all participants. The study was approved by the Institute Ethics Committee.

A total of 178 eyes of patients with immature senile cataract, aged 40-80 years, undergoing uneventful phacoemulsification [with temporal 2.2 mm clear corneal incision, 5.5 mm capsulorrhexis with implantation of non-toric single-piece intraocular lens Tecnis ZCB00 (Abbott Medical Optics, Santa Ana, CA) performed by a single surgeon SK] were examined between March 2018 to July 2018. Cases were allocated into two groups: Group 1 received peribulbar anesthesia using 8 cc of 1:1 mixture of bupivacaine 0.75% and lidocaine 2% (without epinephrine) (admixed with hyaluronidase 15 IU/ml) with a 23

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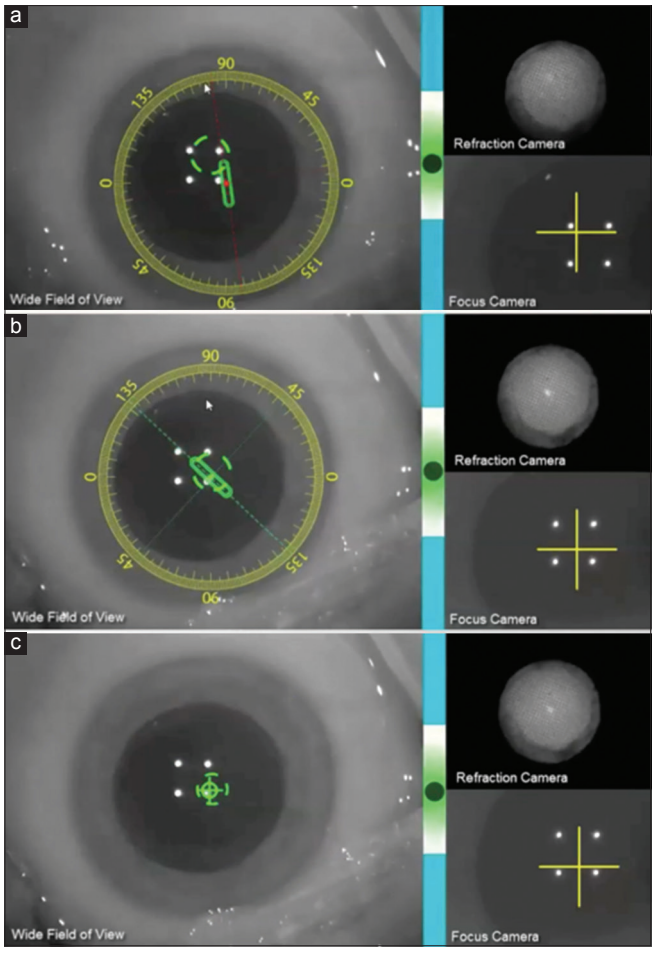

Figure 1: Snapshots of ORA screen showing capturing of aberrometric data when four corneal points are aligned in the centre of fixation in the focus camera and red light (a) changes to green light (b), followed by centering of green cross target (c) by asking the patient to focus in the centre of fixation light in topical anesthesia cases and positioning patient head manually in local anesthesia cases

gauge 25 mm needle, while Group 2 received topical anesthesia with proparacaine hydrochloride 0.5% drops whose instillation was started 4-5 minutes before surgery. Allocation of cases was based on factors like: patient's choice of anesthesia, level of cooperation as assessed by surgeon preoperatively, presence of any hearing impairment or head nodding.

The following cases were excluded from the study: cases with corneal opacity or ectasias, active vitreoretinal disease, axial length > 26.5 mm or < 21 mm, prior refractive surgeries, cataract surgeries with complications e.g. posterior capsular rupture, vitreous loss, IOL placement in sulcus, dislocation of PCIOL, tonic or irregular pupil, poor or no wavefront capture with ORA, cases not willing to give consent for participation/follow-up, any surgical intervention done in the eye previously or any other ocular or systemic condition requiring immediate medical attention.

Preoperatively, optical biometry was performed in all patients using partial coherence interferometry (IOLMaster 500, Carl Zeiss Meditec, Jena, Germany) and IOL power calculated using surgeon's best choice method (i.e., surgeon's choice based on Holladay 1, SRK/T, and Hoffer Q formulas depending upon the axial length). The final IOL power was determined by ORA with slight preference for slight myopia. The expected postoperative spherical equivalent (SE) with this implant power was obtained using IOL Master. Patient particulars and biometry data were entered in ORA just before the beginning of surgery. After phacoemulsification, viscocohesive agent (Healon®, Abbott Medical Optics, Santa Ana, CA, USA) was used to fill the capsular bag upto normotensive level[6] and aphakic refraction was performed using ORA after obtaining ocular alignment.

Table 1: Comparison of preoperative, intraoperative and postoperative parameters between the two groups

Parameter	Peribulbar Anaesthesia Group 1 (*n*=89 eyes)	Topical Anaesthesia Group 2 (*n*=89 eyes)	*P*
Age at presentation	54.51±14.42	53.15±16.23	0.55
Baseline parameters			
Axial Length (mm)	23.84±2.54	23.99±2.12	0.66
Mean Keratometry (D)	43.6±2.59	43.56±2.21	0.91
Intraoperative quality measure of ORA wavefront image	0.93±1.67	0.5±1.18	0.25
Postoperative spherical equivalent at 1 month	-0.32±0.61	-0.32±0.67	0.40

In Group 2, the patients were instructed to look into the red fixation light coming from microscopic attachment of ORA. To perform IA, first the four corneal points seen as four reflected dots in the focus camera view were aligned with the fixation cross and a good focus was achieved [Fig. 1a]. Next, the turning of red light in the wide field of view (WFOV) camera into green [Fig. 1a and b] was taken as the time point for the assistant to press the capture button on screen to start capture of wavefront [Fig. 1b]. WFOV camera then showed the cross target which would initiate capture of wavefront data if eye is well centred [Fig. 1c]. In Group 1, patient head was manually held between two palms by surgeon and positioned, along with moving the patient end of operating microscope using foot control, so as to align the eye into the fixation light of ORA. Any contact with eye speculum was avoided to prevent any extra pressure on the eyelid affecting intraocular pressure.

Intraoperative wavefront quality was assessed from quality score (main outcome measure) available in the form of patient wise data available at the IA manufacturer's website [Fig. 2].[7] A wavefront quality measure of 0 equates to the best quality (least aberrations) and 10 is the worst quality (maximum aberrations) of the wavefront captured. The predicted refractive error by ORA (ORApredicted) and IOL Master (IOLMpredicted) were noted in the two groups and their differences were analyzed. Postoperatively, at 1 month follow-up, single technician performed manifest refraction and mean refractive spherical equivalents were noted. The values were recorded into Microsoft Excelsheet.

Statistical analysis was performed using Statistical Package for the Social Sciences software (SPSS) version 17.0 (SPSS Inc. Chicago, IL, USA). Data expressed as mean ± standard deviation (SD). The pairwise comparison of the continuous data was done using t test (parametric) or two samples Mann-

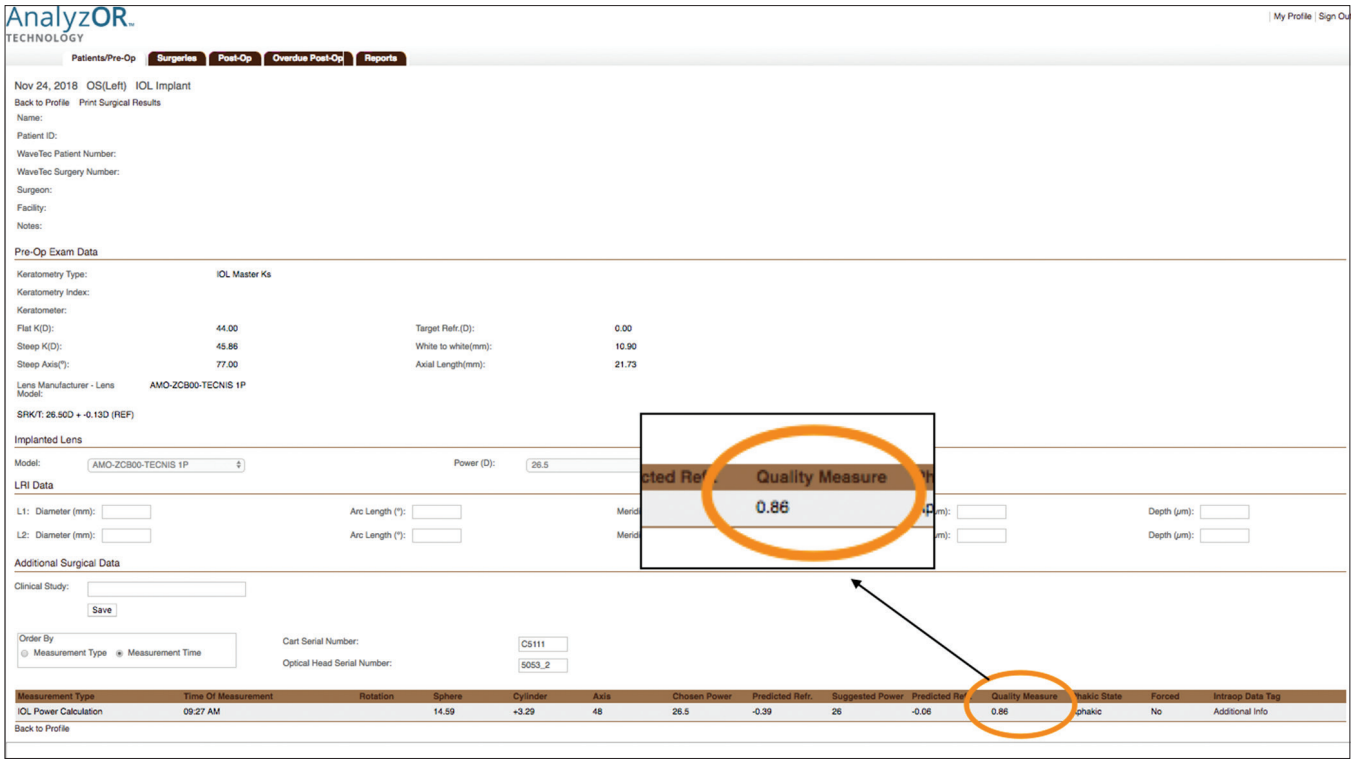

Figure 2: Wavefront quality measure was noted case wise from manufacturer's website, where a lower score indicates a better capture quality

Whitney U-test (non parametric). A *P* value of <0.05 was considered significant.

Results

178 eyes from 178 patients (51% male) with median age 55 (range 40-80) years old were included in this study: 89 patients belonging to Group 1 (peribulbar anesthesia) and rest 89 patients to Group 2 (topical anesthesia). Baseline characteristics like axial length and mean keratometry were comparable between the two groups [Table 1]. The mean difference between ORApredicted and IOLMpredicted IOL Master predicted refractive error was 0.11 ± 0.71 D (-1.07 to +1.79) in all cases.

The wavefront quality score was 0.93 ± 1.67 in the peribulbar anesthesia group, while it was 0.5 ± 1.18 for the topical anesthesia group (*P* = 0.25), whereby higher score suggests a poorer capture of wavefront by ORA. At 1 month, both the groups showed similar spherical equivalent (-0.32 ± 0.61 in peribulbar group versus -0.32 ± 0.67 in topical anaesthesia group) (*P* = 0.4).

In the two groups, the percentages of patients achieving postoperative spherical equivalents within ±0.5D were 69.23% in Group 1 and 73.03% in Group 2 and within ±0.75D were 75.28% in Group 1 and 77.52% in Group 2.

Discussion

Intraoperative aberrometry (IA) is a technique that captures the wavefront and estimates the optical aberrations of eye in aphakic state after cataract removal. It has shown to improve refractive outcomes of cataract surgery, especially in eyes with prior laser vision correction done for myopia.[5] Davison and Potvin reported advantage with use of IA in cases where the difference between IA and preoperative calculations is high.[8] IA has been found not to work well in patients with previous radial keratotomy.[3]

As phacoemulsification techniques continue to advance and decrease the operative time, the need for long duration of anesthesia has reduced.[9] Topical, intracameral and subtenon's methods of anesthesia give adequate pain control and avoid the systemic risks of anesthetic agents.[9–11] However, local anesthesia has to be selected for conditions where topical anesthesia is contraindicated. Poor communication, language barrier, complete deafness, patient unable to follow instructions, insufficient pain control with topical agent (as in prior eye surgery) are absolute contraindications, while photophobia, anxiety, mild deafness and long operative time are relative contraindications to topical anesthesia.[9] This subset of patients who cannot be offered topical anesthesia are currently seen as a limitation to the use of ORA. There is limited literature on the effectiveness of IA under local anesthesia.

We proposed a hypothesis that IOL power estimation with ORA should work equally well for phacoemulsification performed under local anesthesia as for those under topical anesthesia, provided the eye can be aligned in centre by adjusting the head position manually, while watching for the image quality in the focus camera view of IA intraoperatively.

The current study specifically compared the quality measures of the captured wavefront in the patients operated under local anesthesia versus those under topical anesthesia. It

also compared the differences in manifest refractive spherical equivalents at one month postoperatively among the two groups. We concluded that there is no significant difference between measure quality and refractive outcomes obtained with ORA for phacoemulsification performed in local and topical anesthesia. The intraoperatively measured wavefront in the two groups showed similar quality measure.

Most studies in past demonstrating good accuracy of ORA for IOL power determination were performed on older version[3] while the current study was performed on the model upgraded with VerifEye+™ technology. However, short follow-up period is a limitation. Another limitation was that the cases with large difference in the power of the IOL (as suggested by ORA and that calculated with IOL Master) were not excluded from the current study.

Conclusion

The current study highlights the utility of ORA for IOL power estimation for phacoemulsification performed in local anesthesia, thereby extending its use to the subset of patients unfit for cataract surgery under topical anesthesia.

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