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E-mail: info@biomedixdevices.com Website: www.biomedixdevices.com
Anatomical and Visual Outcomes of Descemetopexy in Post Cataract Surgery Descemets’ Membrane Detachment

Dr. Rajat Jain, Dr. Somasheila Murthy, Dr. Sayan Basu, Dr. Md. Hasnat Ali, Dr. Virender Sangwan

Descemet’s membrane detachment (DMD), a potentially vision-threatening complication of cataract surgery, is most often reported after cataract extraction. There is no clarity in existing literature regarding the need for surgical re-attachment and the efficacy of various substances used as tamponade, like 100% air, viscoelastic material, 14% isoexpansile perfluoropropane (C$_3$F$_8$) and 20% sulphur-hexafluoride (SF$_6$). The earlier larger series in this regard reported either 12 cases over a period of 18 years or 15 cases over a period of 15 years. We aim to compare the outcomes of descemetopexy post-cataract surgery with respect to the usage of air or C$_3$F$_8$. To the best of our knowledge, this is the largest such series, the first comparative study published so far and the first to report the association of various factors, which could be responsible for the final visual outcome in these patients.

MATERIALS AND METHODS

Study Design and Subjects

This retrospective study was approved by the Institutional Review Board. A prior written informed consent was obtained from all patients for all the surgical procedures and the investigations which they underwent. This study included patients who underwent anterior chamber gas injection (descemetopexy) for the treatment of post cataract surgery Descemet’s membrane detachment (DMD), between 1st January 2007 and 31st December 2011. Patients who had DMD, which was recognized during surgery and were treated with descemetopexy at the same setting, and patients without a minimum follow-up of 1 month were excluded from the study. Forty-four patients who fulfilled the inclusion criteria were included in the study. Further, 16 patients were referred to our institute with the diagnosis of post cataract surgery DM detachment and were also included in the study, thus making it a total of 60 patients.

Data Collection

The data retrieved from the medical records was both demographical and clinical. A specialized cataract scoring system was used to assess the severity of the cataract. The severity of the DMD was considered to be mild if it involved <25% of the cornea and was peripheral, moderate if it involved 25-
50% cornea and was peripheral, and severe if it involved >50% of the cornea or involved the central cornea. Other details noted were the type of gas used for anterior chamber injection and any intra or post-operative complications. Postoperative details at 1 month included status of DM attachment and best corrected visual acuity (post-op logMAR).

**Outcome Measures**

At 1 month, assessment was done for the final status of the detached portion of the DM (anatomical) and the improvement in the interval visual acuity (IVA) (functional). The secondary outcome measures included complications of the procedure and the association of various factors with the final visual outcome.

**Preoperative Examination**

All patients underwent comprehensive postoperative examination when the DMD was noted. Patients having mild detachment underwent surgery if the DMD persisted at follow-up. The timing of the surgery depended on the treating physician. Other moderate or severe DMDs were treated surgically on the same day. Some patients underwent a Visante anterior segment optical coherence tomography (Carl Zeiss Meditec, Dublin, CA) (AS-OCT) to delineate the exact location and extent of the DMD.

**Surgical Technique**

Descemetopexy was performed under aseptic precautions under an operating microscope. A 26G cannula was mounted on a 5ml disposable syringe which was filled either with 100% air or isoexpansile mixture of 14% C₃F₈, the choice of which was pre-decided and was based on the operating surgeon's preference. An anterior chamber paracentesis was made with a micro vitreo-retinal blade and the syringe filled with gas or air was inserted into the anterior chamber. A continuous, single bubble of the gas was aimed into the anterior chamber. Once a complete gas-filled chamber was maintained, the side-port entry was hydrated or sutured with 10-0 monofilament nylon suture.

**Postoperative Management**

On the first postoperative day, the patient was examined specifically to assess the attachment of the DM. A standard postoperative treatment was administered. The surgical procedure was repeated if the DMD persisted on the first postoperative day, based on either a slit lamp evaluation or AS-OCT imaging based diagnosis or persistent detachment. Statistical Analysis: Statistical analysis was performed using R (V.2.14.2) statistical software. A two-tailed t-test was applied to assess the significance of the improvement in the IVA after the surgical procedure. A multiple linear regression analysis was performed in this study as the outcome (visual acuity) is a continuous variable.
RESULTS

Patient Population

The mean age of the patients was 64.3 ± 8.28 years, male: female ratio was 21:39 and the ratio of the right and left eye involvement was 36:24. The median DMD severity was 3 (IQR=0) and the median cataract score was 3 (IQR=1.25). The distribution of DMD severity and cataract score with the visual acuity is summarized in Table 1 and 2. DMD occurred after small incision cataract surgery (SICS, n=44), phacoemulsification via scleral incision (n=14) or conventional extracapsular cataract surgery (ECCE, n=2). The average time period between the cataract surgery and descemetopexy post-DMD was 11.46+13 days.

Outcome assessment

At 1 month, the mean logMAR IV A improved from 1.27 ± 0.8 (range: 0.18 to 3; 95%CI: 1.07 to 1.47) to 0.42 ± 0.49 (range: 0 to 2; 95%CI: 0.3 to 0.54) (p<0.001). Ninety-five percent (57/60) patients had a successful reattachment of the DM after the intervention. Nine patients required the intervention to be repeated twice. Pre-operatively, this group was comparable to the group of patients in whom descemetopexy was done only once in age (p=0.93), cataract score (p=0.47), DMD severity (p=0.78) and pre-op IV A (p=0.30). At 1 month, there was no statistical difference in the mean post-op IV A (p=0.77), patients attaining 20/20 vision (p=0.43), patients attaining 20/40 or better vision (p=0.28), rates of failure of DM attachment (p=0.33) and the incidence of pupillary block (p=0.42). Multiple linear regression showed that the factors associated with a significantly poorer final visual outcome were found in patients with a cataract score of 5 (p=0.014), a cataract score of 4 with compromised visibility due to a corneal opacity (p=0.039) and prolonged duration between the cataract surgery and descemetopexy (p=0.007). The factors associated with statistically significantly better IVA were found in patients in whom phacoemulsification from the scleral incision (p=0.02) or conventional extracapsular cataract extraction (p=0.013) was done and in whom air was used as the agent for anterior chamber injection (p=0.009). No association of final visual outcome was seen with age, gender, eye treated, cataract scores 3 and 4, pre-operative visual acuity, involvement of the visual axis and intra-operative visibility, as regards the corneal pathology (p>0.5).

<table>
<thead>
<tr>
<th>Table 1: IVA in various DMD severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMD Severity</td>
</tr>
<tr>
<td>Mild</td>
</tr>
<tr>
<td>Moderate</td>
</tr>
<tr>
<td>Severe</td>
</tr>
</tbody>
</table>
Three patients (5%) with persistent DMD and corneal edema required subsequent endothelial transplantation for visual rehabilitation. Failure rate was similar with air or C$_3$F$_8$ ($p=0.44$).

Early post-descemetopexy pupillary block was seen in 7 cases (11.66%) in which C$_3$F$_8$ had been used and in none of the eyes treated with air ($p=0.02$).

### DISCUSSION

Descemet’s membrane detachment is a rare occurrence, post cataract surgery. The majority of DMDs were noted in small incision cataract surgery at the ACM port in our series. An early

### Table 2: Pre-operative data in groups of patients treated with Air or Perfluoropropane

<table>
<thead>
<tr>
<th></th>
<th>Air (n=24)</th>
<th>C$_3$F$_8$ (n=36)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>64.16</td>
<td>64.4</td>
<td>0.9</td>
</tr>
<tr>
<td>SD</td>
<td>9.33</td>
<td>7.76</td>
<td></td>
</tr>
<tr>
<td>95% CI</td>
<td>60.72 to 67.61</td>
<td>61.63 to 67.25</td>
<td></td>
</tr>
<tr>
<td>Sex (M/T)</td>
<td>10/24</td>
<td>21.88% to 61.32%</td>
<td>0.15</td>
</tr>
<tr>
<td>Eye (OD/T)</td>
<td>6/24</td>
<td>7.68% to 42.32%</td>
<td>0.03</td>
</tr>
<tr>
<td>Cataract Score</td>
<td>3.41</td>
<td>3.3</td>
<td>0.7</td>
</tr>
<tr>
<td>SD</td>
<td>1.13</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>95% CI</td>
<td>2.97 to 3.95</td>
<td>10.36 to 3.66</td>
<td></td>
</tr>
<tr>
<td>Corneal Pathology</td>
<td>3.41</td>
<td>3.3</td>
<td>0.12</td>
</tr>
<tr>
<td>SD</td>
<td>1.13</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>95% CI</td>
<td>2.97 to 3.95</td>
<td>10.36 to 3.66</td>
<td></td>
</tr>
<tr>
<td>DM severity</td>
<td>2.95</td>
<td>0.2</td>
<td>0.21</td>
</tr>
<tr>
<td>SD</td>
<td>0.2</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>95% CI</td>
<td>2.78 to 3.13</td>
<td>2.63 to 2.92</td>
<td></td>
</tr>
<tr>
<td>Pre-op IVA</td>
<td>0.12</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>0.19</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>95% CI</td>
<td>0.05 to 0.2</td>
<td>0.13 to 0.25</td>
<td></td>
</tr>
</tbody>
</table>

C$_3$F$_8$ – Perfluoropropane, M – Male, T – Total, OD – Oculus Dexter (Right Eye), SD – Standard Deviation, CI – Confidence interval, p – p value

**Figure 1:**

A. Slit Lamp photo of a case of a large area of DMD with profound corneal edema.
B. Post-operative day 1 slit lamp photo showing the decreased corneal edema and an air bubble filling half of the anterior chamber.
C. ASOCT image of the same case pre-operatively showing a detached DM.
D. Post-op day 1 showing DM apposed to the posterior stroma.
E. Slit lamp photos of the same case at post-operative day 8. and F. day 30.
intervention by descemetopexy was associated with a good final anatomical and visual outcome. Air descemetopexy is recommended over C₃F₈ injection, because of its equal efficacy and lack of complications. To our knowledge and after a literature search using PubMed, this is the only study that describes the risk factors for visual prognosis and compares the visual and safety outcomes of air and C₃F₈.

**REFERENCES**


**A Comparative Evaluation of Intravitreal Bevacizumab (Avastin) and Posterior Sub-Tenon’s Triamcinolone Acetonide in Diffuse Diabetic Macular Edema**

**Dr. Biresh Raj, Dr. Rakesh Maggon, Dr. Shyam Sundar, Dr. Anirudh Singh, Dr. Alok Sati**

Diabetic macular edema (DME) continues to be the paramount cause of visual loss in diabetic patients. The visual impairment from untreated macular edema often leads to legal blindness and has a significant detrimental
effect on quality of life. Approximately one diabetic patient in four can be expected to develop DME in his lifetime.\(^1\)

ETDRS gave the treatment strategy of laser photocoagulation for DME and this has been followed worldwide.\(^2\) Laser photocoagulation is a late and destructive treatment that does not take the etiology of disease into account. Most of the diabetes related complications like macular edema and neovascularization occur secondary to the release of the growth factors in response to retinal ischemia.\(^3\) Inhibition of these growth factors is an important way to treat DME which can be achieved by anti-vascular endothelial growth factor (anti-VEGF) or corticosteroids or combination of both. Both IVB and PSTA have shown marked reduction in macular edema, also accompanied by improvement in visual acuity.\(^4\)\(^5\) The aim of this study is to assess and compare the changes in visual acuity and macular thickness on OCT in patients receiving either bevacizumab or triamcinolone acetonide.

**MATERIALS AND METHODS**

This prospective, comparative study included 60 eyes (30 patients) with DDME presenting with 20/30 or worse visual acuity, which consecutively underwent either IVB or PSTA with 4 weeks of follow-up. The inclusion criteria were as follows: The patents had a recently diagnosed DDME by slit lamp biomicroscopy (SLM) with non contact + 90D lens and confirmed by fundus fluorescein angiography (FFA); macular thickness ≥ 300 um as measured by OCT and a baseline visual acuity of 20/30 or worse. All patients had metabolically stable DM with glycosylated haemoglobin ≤ 7.0 mg/dl. DDME was defined as generalized areas of leakage in the area centralis on FFA. The exclusion criteria were previous treatment for DDME, such as Laser photocoagulation, IVB, Posterior sub-tenon's or intravitreal triamcinolone acetonide; macular edema secondary to other causes, such as age-related macular degeneration and vascular occlusive diseases, a history of glaucoma and patients with uncontrolled diabetes, hypertension, chronic renal failure, hyperlipidemia, ischemic heart disease and history of stroke.

All patients underwent the following baseline investigations: Blood haemoglobin, glycosylated haemoglobin (HbA1c), systolic and diastolic blood pressure (two readings taken two to three minutes apart in the right arm in sitting position), blood urea, serum creatinine, spot urine albumin and total lipid profile including serum cholesterol, triglyceride, low-density lipoprotein (LDL), high-density lipoprotein (HDL) and very low-density lipoprotein (VLDL).

At baseline, all the patients underwent a comprehensive ocular examination, including BCVA with Snellen's chart, applanation tonometry, ophthalmoscopy, SLM, FFA and OCT (Stratus OCT; Carl Zeiss Meditec, Dublin, Calif.). An IVB
(Avastin; Genentech Inc; San Francisco, CA) 1.25mg/0.05ml was given in one eye and PSTA 40mg/1ml was given in other eye under sterile conditions. After the injection, a topical antibiotic drop was applied and the patients were monitored for injection-related complications.

The main outcome measures were visual acuity and CMT at four weeks after the injection. Statistical analysis was performed using a commercially available statistical software package (SPSS for windows, version 12.0; SPSS, Chicago, IL, USA) Visual acuity was converted into decimal scale for statistical analysis. The paired t-test was used for comparison of preoperative and postoperative BCVA and CMT. The multiple regression analysis was performed to evaluate the associated factors influencing treatment success. The level of statistical significance was set at 0.05 (two-sided) in all statistical testing.

RESULTS

The mean age of the patients was 62.2±4.42 years (range 46-78 years). The mean baseline visual acuity (decimal) in IVB group was 0.3380±0.19 and 0.3350±0.218 in PSTA group. The mean baseline CMT (µm) in IVB group was 411.86±106.64 and 391.20±93.38 in PSTA group.

At 4 weeks, BCVA improved to 0.3853±0.20 from 0.3380±0.19 (p=0.003) in IVB group and 0.3938±0.185 from 0.3350±0.218 (p=0.031) in PSTA group. The improvement in BCVA was statistically significant in both groups. However the difference in BCVA were not statistically significant between the two groups (p=0.938) which suggested that both the drugs are equally effective in improving the vision. At 4 weeks, six of the 30 eyes (20%) from bevacizumab group and five of the 30 eyes (17%) from the triamcinolone group improved in the BCVA, more than two lines.

The mean CMT as measured by OCT also decreased significantly in IVB group to 348.63±74.75 µm from 411.86±106.64 µm at 4 weeks follow-up (p=0.000). The mean CMT in PSTA group decreased from 391.20±93.38 µm at baseline to 306±75.107 µm at 4 weeks follow-up (p=0.000). Both the drugs are significantly effective in reducing the macular thickness but CMT was reduced more in the bevacizumab group than in the triamcinolone group (p=0.035). Three of the 30 eyes (10%) in IVB group and 4 of the 30 eyes (13%) in PSTA group had persistent macular edema at 4 weeks.

There were no complications, including elevation of intraocular pressure, progression of cataract, vitreous hemorrhage, retinal detachment and endophthalmitis in the study groups.

DISCUSSION

Most of the diabetes related complications like macular edema and neovascularization occur secondary to the release of the growth factors in response
to retinal ischemia from alterations in the structure and cellular composition of the microvasculature. VEGF increases vascular permeability by relaxing endothelial cell junctions. Thus inhibition of these growth factors is an important way to treat DDME which can be achieved by anti-VEGF agents or corticosteroids or combination of both.

Several studies involving a reduction in macular edema due to DM with triamcinolone or bevacizumab have revealed a promising results. Corticosteroids have been demonstrated to inhibit the expression of the VEGF gene. Nauck et. al. demonstrated that corticosteroids abolished the induction of VEGF by the pro-inflammatory mediators, such as pigment-derived growth factor (PDGF) and platelet-activating factor (PAF), in a time and dose-dependent manner. Thus, corticosteroids down-regulate VEGF production and possibly prevent breakdown of the blood-retinal barrier. Similarly, steroids have anti-angiogenic properties possibly due to attenuation of the effects of VEGF. Both of these steroid effects have been utilized as intravitreal or posterior sub-tenon’s injection to cause temporary reduction of edema even prior to laser photocoagulation in DME and neovascularization in various studies.

Anti-VEGF agents, such as bevacizumab, exert direct, strong inhibition of VEGF. Bevacizumab is a full-length humanized monoclonal antibody that binds and inhibits all biologically active isoforms of VEGF. Although preclinical experimental data from primates suggested that the full-length antibody might not penetrate the internal limiting membrane of the retina, recent studies have shown full-thickness penetration of the retina within 24 hours. A recent report from the Pan-American Collaborative Retina Study Group showed a significant decrease of DDME one month after IVB, and those decreased levels were kept for up to six months. Primary IVB at doses of 1.25 to 2.5mg seems to provide stability or improvement in BCVA in DDME at 24 months.

Reasons to use bevacizumab in DME are fast onset of improved retinal morphology, visual acuity and dramatic improvement in OCT appearance. Other reasons include its low cost and easy availability, with no unexpected toxicity shown to date. But the major problems with anti-VEGF are that they have to be often repeated frequently as most of the therapeutic benefit wear off within one month.

Since both corticosteroid and anti-VEGF reduces macular edema, we evaluated the effectiveness of PSTA against IVB in patients with DDME. The results of our study indicate that both IVB and PSTA have a similar beneficial effect on retinal thickness and VA independently. But when both IVB and PSTA were compared with each other, it was found that IVB work more effectively then PSTA to decrease of CMT. Bevacizumab is effective for DDME although this
technique is off-level use, requires operation theatre, is expensive and carries a risk of endophthalmitis because the drug is injected directly into the eye. The use of PSTA is quiet safe; out-door inexpensive procedure which is equally effective for DDME.

According to our study, triamcinolone acetonide can be used effectively for the treatment of DDME in developing countries like India. However, the limitations of this study were small number of participants and a short follow up. So further studies are warranted with relatively greater number of participants and a longer follow-up.

REFERENCES
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Corneal Collagen Crosslinking (CXL) for Keratoconus: Transepithelial Technique Vs Conventional Method

Dr. Shikha Gupta, Dr. Sasikala Nindra Krishna, Dr. Anita Panda

The transepithelial technique of CXL is an alternative to conventional method of CXL to overcome the subepithelial haze and any chances of infection with the debrided epithelium with proven results to halt the progression of keratoconus.

To compare transepithelial vs de-epithelization technique of corneal collagen crosslinking (CXL) in patients of keratoconus.

MATERIALS AND METHODS

Ethical clearance was obtained from the Institutional Review Board prior to conducting this study. 20 consecutive patients presenting to cornea services at a tertiary care centre with documented keratoconus progression on topography over at least one year follow up were selected and informed consent for the procedure was obtained. These patients were then randomly allocated to either of the two groups in a double blinded fashion (Randomized control trial). Inclusion criteria included patients with age more than 18 years, documented keratoconus progression in the past 12 months, no evidence of corneal scarring and corneal thickness at the thinnest point ≥ 400µm.

20 eyes (20 patients) with progressive keratoconus were subjected to transepithelial CXL (10 eyes; group I), and conventional CXL (10 eyes; group II). The procedure was carried out under strict aseptic conditions in the operation theatre. In the epithelium on method, Proparacaine (0.5%) anaesthetic drops were instilled thrice every 5 minutes before the introduction of isotonic solution of 0.1% riboflavin in 20% dextran. The eye was then cleaned and draped, riboflavin drops were instilled every 3 to 5 minutes for 30 minutes, along with frequent proparacaine eye drops, followed by Ultraviolet-A (UVA) radiation (wave length 765 nm; CL-UVR machine, Appasamy Associates, India) for next 30 minutes with associated use of riboflavin and proparacaine eye drops every 3 to 5 minutes. Proparacaine drops were preserved with 0.01% benzalkonium chloride which enhances penetration of riboflavin by chemical disruption of tight junctions in the epithelium.

For group II patients (epithelium off), epithelial debridement was done by scraping off the wet epithelium with a spatula followed by similar protocol as mentioned above. A soft bandage contact lens was prescribed to these patients at the end. After the procedure, topical moxifloxacin 0.3%, prednisolone acetate 1% and tear substitute each was prescribed four times a day for one
Table 1: CDVA, keratometry (steepest/ flattest and astigmatism) between groups I and II at each follow up. (CDVA corrected distance visual acuity, steepest keratometry Ks, flattest keratometry Kf, keratometric astigmatism Ka)

<table>
<thead>
<tr>
<th>(Mean ± SD)</th>
<th>Pre-op (A)</th>
<th>1 mon (B)</th>
<th>p (A-B)</th>
<th>3 mon (C)</th>
<th>p (A-C)</th>
<th>6 mon (D)</th>
<th>p (A-D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (CDVA)</td>
<td>0.327 ± 0.1</td>
<td>0.32 ± 0.09</td>
<td>0.00</td>
<td>0.3 ± 0.07</td>
<td>0.00</td>
<td>0.23 ± 0.08</td>
<td>0.00</td>
</tr>
<tr>
<td>II (CDVA)</td>
<td>0.36 ± 0.08</td>
<td>0.3 ± 0.08</td>
<td>0.00</td>
<td>0.29 ± 0.04</td>
<td>0.00</td>
<td>0.6 ± 0.08</td>
<td>0.00</td>
</tr>
<tr>
<td>I (Ks)</td>
<td>53.64 ± 4.1</td>
<td>52.34 ± 3.96</td>
<td>0.006</td>
<td>51.83 ± 4.19</td>
<td>0.001</td>
<td>50.39 ± 4.57</td>
<td>0.002</td>
</tr>
<tr>
<td>II (Ks)</td>
<td>53.91 ± 3.77</td>
<td>52.34 ± 3.96</td>
<td>0.004</td>
<td>51.35 ± 4.38</td>
<td>0.001</td>
<td>50.51 ± 4.49</td>
<td>0.008</td>
</tr>
<tr>
<td>I (Kf)</td>
<td>47.74 ± 4.72</td>
<td>46.92 ± 4.41</td>
<td>0.014</td>
<td>46.45 ± 4.45</td>
<td>0.003</td>
<td>46.1 ± 4.58</td>
<td>0.015</td>
</tr>
<tr>
<td>II (Kf)</td>
<td>47.17 ± 4.6</td>
<td>46.4 ± 4.56</td>
<td>0.020</td>
<td>46.1 ± 4.54</td>
<td>0.004</td>
<td>46.05 ± 4.58</td>
<td>0.014</td>
</tr>
<tr>
<td>I (Ka)</td>
<td>5.9 ± 2.25</td>
<td>5.59 ± 2.46</td>
<td>NS</td>
<td>5.38 ± 2.73</td>
<td>NS</td>
<td>4.29 ± 2.28</td>
<td>0.014</td>
</tr>
<tr>
<td>II (Ka)</td>
<td>6.73 ± 2.81</td>
<td>5.93 ± 2.59</td>
<td>0.014</td>
<td>5.24 ± 2.79</td>
<td>0.012</td>
<td>4.46 ± 2.84</td>
<td>0.014</td>
</tr>
</tbody>
</table>

Table 2: Endothelial cell density (ECD) in the two groups at baseline and follow up. Note there is no statistical difference from baseline value at any time.

<table>
<thead>
<tr>
<th>Mean ECD (Cells/ mm2)</th>
<th>Group I</th>
<th>P value</th>
<th>Group II</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre CXL</td>
<td>2366.5 ± 218.297</td>
<td></td>
<td>2265.4 ± 176.3</td>
<td></td>
</tr>
<tr>
<td>3 months</td>
<td>2362.45 ± 218.23</td>
<td>0.6</td>
<td>2268.8 ± 171.9</td>
<td>0.6</td>
</tr>
<tr>
<td>6 months</td>
<td>2368.8 ± 229.765</td>
<td>0.9</td>
<td>2250.5 ± 167.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Change from baseline to last follow up</td>
<td>6.2 ± 81.4</td>
<td>0.7</td>
<td>14.9 ± 10.5</td>
<td>0.7</td>
</tr>
</tbody>
</table>
week to all patients. UCDVA, CDVA, topography (VKG, orbscan), pachymetry and Endothelial cell density (ECD) were documented at baseline and at each follow up visit for a minimum of 6 months.

**Data analysis**

Statistical analysis was done by paired sample t-tests for pre and post results. For calculating the difference between the values of the two groups at baseline and after therapy, two sample t-test was applied. Significance value was set at p value < 0.05.

**RESULTS**

The mean age of patients of both the groups comprised together was 22.35 ± 3.95 years, (range 18-26 years). There was no significant difference in the age of patients between the two groups. Results: Mean BCVA improved from Log Mar 0.327 ± 0.1 (Group 1), 0.36 ± 0.08 (Group 2) to 0.23 ± 0.08 (Group 1; p<0.001), 0.22 ± 0.06 (Group 2; p<0.001) respectively at 6 months. Mean Sim K astigmatism decreased from 6.6±1.93 D (Group 1), 6.6±1.93D (Group 2) to 5.14±1.86 D (Group 1; p 0.001), and 4.77±0.06 (Group 2; p 0.001) respectively at 6 months. The mean pachymetry improved from 422 ± 15.86 µm (Group 1), 424 ± 27 µm (Group 2) to 427 ± 13.66 µm (Group 1), 427 ± 20 µm (Group 2) respectively at 6 months (p NS). All cases showed stabilization of keratoconus. There was no significant difference in any of the baseline or final parameters in between the two groups. Moreover, none of the eyes developed any untoward effects. All the patients in Group II experienced pain and photophobia on first 2 days but not in Group I.

None of the eyes presented with post cross-linking subepithelial haze, infection, sterile infiltrates, edema or any significant rise in intraocular tension. No adverse systemic events were noted in the treatment population.

In conclusions transepithelial technique offers visual and topographic outcomes and post-operative results akin to conventional method with superior patient comfort post intervention.

**Incision Integrity and Clinical Outcomes Following Microcoaxial Cataract Surgery: Comparison of 1.8mm and 2.2mm system**

**Dr. Vaishali Vasavada, Dr. Abhay R. Vasavada, Dr. Viraj A. Vasavada, Dr. Lajja Shastri, Dr. Samaresh Srivastava**

With improvements in phacoemulsification machines, surgical techniques, and newer IOL delivery systems, the size of the clear corneal incision is
The advantages of small incisions during cataract surgery are well known, and include reduced surgically induced astigmatism (SIA), reduced intraoperative and postoperative inflammation, and faster visual rehabilitation.\textsuperscript{1,2}

With widespread adoption of smaller incision phacoemulsification techniques, microcoaxial phacoemulsification (MCP) has gained popularity\textsuperscript{3,4} However, wound integrity could be a concern when using very small incisions. Smaller incisions are not necessarily better. These incisions require the use of compatible instrumentation and IOL delivery systems in order to avoid thermal injury, wound distortion and corneal hydration. Currently, there are two popular systems for performing MCP: the 2.2mm incision system and the 1.8mm incision system, both available on two different platforms. Both approaches have been reported to be safe and effective\textsuperscript{5,6} during emulsification of age-related cataracts.

In a previous randomized, experimental trial we found that stromal collagen denaturation and damage was greater when performing MCP through a 1.8 mm incision as compared to a 2.2 mm incision (Paper presentation at annual meeting of the ASCRS, 2011, San Diego; “Histomorphological and Immunofluorescence evaluation of clear corneal incisions following Microcoaxial phacoemulsification performed through 1.8 and 2.2mm : Randomized, Experimental Trial” Vasavada VA, et. al.).

Luo and colleagues in their study\textsuperscript{6} questioned the integrity of the 1.8mm incision as compare to the 2.2mm incision. However, there is still not enough information in literature comparing the incision integrity as well as postoperative outcomes following MCP with these two popular incision sizes – 1.8mm and 2.2mm. The aim of this study was to compare incision integrity and postoperative outcomes following MCP with two popular systems using the 1.8mm and 2.2mm incisions respectively.

**MATERIALS AND METHODS**

This prospective, randomized, patient and analyzer masked clinical trial comprised 100 patients with uncomplicated age-related cataracts undergoing phacoemulsification at Iladevi Cataract and IOL Research Centre, Ahmedabad, India, from September 2011 to February 2012. The study was approved by the Institutional Review Board and informed consent was obtained from all the patients prior to enrollment. The study followed the ICH-good clinical practice (GCP) guidelines. The study is registered with clinicaltrials.gov (NCT01385878)

Patients having nuclear or corticonuclear cataracts of grade 2 to 4 according to the LOCS III Classification were included.\textsuperscript{7} The following exclusion criteria were exercised: presence of glaucoma, shallow anterior chamber (ACD <
2.1mm), pupillary dilatation < 6mm, extremely dense cataracts, posterior polar cataract, subluxated cataract, white mature cataract, diabetic retinopathy, high myopia (defined as AL > 25mm), uveitis, or previous ocular trauma / surgery. Patients were randomized to one of two groups based on the incision size and phacoemulsification system used: In Group I (50 eyes), MCP was performed through a 1.8mm clear corneal incision on the Stellaris PC system (Bausch & Lomb) using longitudinal ultrasound. In Group 2 (50 eyes), MCP was performed through a 2.2mm clear corneal incision on the Infiniti Vision system (Alcon Laboratories, USA) using torsional ultrasound.

**Surgical Technique**

All surgeries were performed by a single, experienced surgeon (ARV), who was familiar with both systems. An initial 1.0mm corneal paracentesis incision was created, followed by injection of dispersive ophthalmic viscosurgical device (OVD) (Viscoat, Alcon Labs, USA) and cohesive OVD (Provisc, Alcon Labs, USA) as per the soft shell technique. A single-plane, temporal, clear corneal incision was made with an internal entry length of at least 1.5 mm. The internal entry in all eyes was measured using specially designed calipers that measure length in steps of 0.1mm (Titanox, India). Anterior capsulorhexis was performed using cystotome and microcapsulorhexis forceps (ASICO, USA). Multiquadrant, cortical-cleaving hydrodissection was performed. Phacoemulsification was performed using a standardized technique. Standardized parameters were used in both groups for emulsification, depending on the grade of nuclear sclerosis. Bimanual irrigation / aspiraton (I/A) was performed for cortex removal. In all eyes, a single-piece foldable intraocular lens (IOL) was injected in the bag using an injector system compatible with the incision, without enlarging the main incision. The OVD was aspirated using bimanual I/A. Postoperatively, all patients used topical steroid eye drops 4 times a day for 2 weeks, after which the regimen was tapered by 1 drop for 3 weeks.

In Group I, a 1.8mm temporal, clear corneal incision was made using a 1.8mm laser-edge steel trapezoidal knife (Bausch U Lomb, USA). A sleeved 1.8 mm C-MICS tip (Bausch & Lomb) was used. Longitudinal ultrasound was used in the pulse mode. Dual linear foot pedal control available on the machine was used. An MI60 IOL (hydrophilic acrylic, Bausch & Lomb) was implanted in the capsular bag using the Viscoject 1.8 injector system (Medicel, Switzerland) with the Viscoglide™ cartridge.

For the Infiniti system, a 2.2mm temporal, clear corneal incision was made using a 2.2mm anterior bevel Intrepid knife (hydrophobic acrylic, Alcon Labs, USA). A 0.9mm mini-flared 45° ABS Kelman tip was used with an Ultra sleeve (Alcon Labs, USA). Torsional ultrasound was used in the pulse mode. An AcrySof SN60WF IOL (Alcon Laboratories) was implanted in the capsular bag.
using a Royale III injector (ASICO, USA) and D-cartridge (Alcon Labs, USA).

The incision width was measured using an incision gauge (Titanox, India) measuring in steps of 0.1 mm, at the following time points: after incision, after phacoemulsification, and after IOL implantation. The total surgical time (defined as the time duration from beginning of sculpting to the end of last quadrant removal) and the volume of balanced salt solution (BSS) used from beginning of surgery to end of nuclear quadrant removal were recorded at the end of surgery in both groups.

At the end of cataract surgery, stromal hydration was performed on all the incisions. Following hydration of the incisions, the speculum was removed from the eye. Thereafter, trypan blue (TB 0.0125%, pH=7.39, osmotic pressure=1.22, Shah & Shah, India) was applied over the conjunctival surface using a micropipette. After a waiting period of 2 minutes, the surface was irrigated with balanced salt solution (BSS) to wash away the residual trypan blue on the ocular surface. Anterior chamber aspirates of 0.1 ml were obtained in all eyes using a 27-gauge cannula mounted on a tuberculin syringe through the paracentesis incision. Trypan blue levels were measured from this aspirate. After the aspirate was taken, the speculum was reinserted, and 0.1 ml of preservative-free moxifloxacin (Vigamox®) was injected into the anterior chamber.

**Quantifying Trypan Blue Ingress**

Trypan blue measurements were obtained as described in our previous publication. An ultraviolet visible spectrophotometer (Perkin Elmer, Lambda 25) was used to measure the optical density of the Trypan blue solution. The dilution factors were then converted into log values that were used for statistical analysis.

The Mann-Whitney test and Kruskal Wallis test was used for statistical analysis to compare values between the two groups.

**Intraoperative Outcome Measures**

Amount of trypan ingress in the anterior chamber, volume of BSS used, CDE and total surgical time were compared between the two groups.

**Postoperative Outcome Measures**

Central corneal thickness (CCT) was measured using ultrasonic pachymetry (Ocuscan, Alcon) preoperatively and postoperatively at 1 day, 1 week and 1 month follow-up. Percentage change in CCT from preoperative was calculated as: (Preoperative - postoperative) / preoperative X 100. Manual keratometry was performed preoperatively and postoperatively at 3 months on the Topcon OMS-4 keratometer. Surgically induced astigmatism (SIA) was calculated using the 3 month postoperative keratometric power using vector
analysis. Corneal endothelium was evaluated by measuring the endothelial cell density (ECD) and coefficient of variation (CV) preoperatively and 3 months postoperatively. Endothelial cell loss (ECL) was defined as: % ECL = (Preoperative - postoperative) / preoperative X 100. Endothelial cell counts in the central cornea were performed using a non contact specular microscope (SP 2000P; Topcon, Japan). Anterior segment inflammation was graded on the slit lamp on postoperative day 1, 1 week and 1 month using Hogan’s criteria11 for grading anterior chamber cells and flare. Corneal clarity was graded on slit lamp as presence of Descemet’s folds (generalized/localized, centrally/ localized close to incision) and presence of generalized / localized epithelial edema. Monocular unaided visual acuity (UAVA) on day 1, and best corrected visual acuity (BCVA) at 3 months follow-up were compared between the groups.

**Incision Morphology on Anterior Segment Optical Coherence Tomography (OCT)**

The morphology of the temporal, clear corneal incision was evaluated on the anterior segment OCT (AS-OCT) (Visante™, Carl Zeiss) 1 day, 1 week and 1 month postoperatively.

A high-resolution mode was used to capture images. Scans 10.0 mm long and 3.0 mm deep were taken with an 18.0 mm optical axial resolution and 60.0 mm transversal resolution. The eye position and the location of the cross-section were verified by a charge-coupled device camera.

The following were analyzed on the image: (1) incision angle (angle between the line that joins the epithelial and endothelial ends of the incision and the tangential line on the corneal surface); (2) existence of a gap on the epithelial side of the incision; (3) presence of a gap, or misalignment on the endothelial side of the incision (4) local Descemet membrane detachment (5) corneal thickness 1mm temporal to the incision

All these examinations were performed by one of two trained examiners, both of whom were masked to the patients’ group assignment.

**Sample Size Calculation**

The sample size of 100 patients was computed using observations from a pilot study of 10 patients in each of the 2 phacoemulsification technique groups. Concentration of trypan blue in the anterior chamber aspirate was the primary outcome measure. A difference of 0.175 log units or more was considered relevant for this study. A sample size of 50 patients in each group would have 80% power to capture the above-mentioned difference between the 2 groups.

**Statistical Analysis**

Statistical analysis was performed using SPSS software (Version 12, SPSS Inc)
using the Mann-Whitney Test, Fischer’s Exact Test and Student’s T-test. P value of less than 0.005 was considered statistically significant.

RESULTS
The mean age of patients was 64.42 + 5.43 years in Group I, and 62.67 + 8.79 years in Group II (p=0.52). The male : female ratio was 0.92 in Group I and 1.04 in Group II (p=0.73). No patients were lost to follow-up. Mean grade of nuclear sclerosis in Groups I and II was comparable (3.01 + 0.65 and 3.11 + 0.50, p = 0.67)

Intraoperative Parameters
The total surgical time, CDE, and volume of BSS used. Total surgical time was significantly greater in Group I as compared to Group II (p<0.0001). Volume of BSS used and CDE were comparable.

Incision Enlargement
Incision enlargement from initial incision to end of IOL implantation was significantly greater in Group I compared to Group II (p<0.0001). When further analyzing, enlargement from initial incision to the end of phacoemulsification was significantly greater in Group I as compared to Group II. However, incision enlargement from end of phacoemulsification to the end of IOL implantation was comparable between the groups.

Trypan Blue Ingress into the anterior chamber
Logs of denominators of trypan blue in the anterior chamber. The lower log values observed indicate higher trypan blue content in the aspirate and therefore a higher level of ingress into the anterior chamber originating from the ocular surface. The difference in the mean measurements between groups was statistically significant (P<0.0001). The 1.8mm group had significantly greater ingress of trypan blue as compared to the 2.2mm group.

Surgically Induced Astigmatism (SIA)
Although the magnitude of SIA was greater in Group I, the difference between the groups in was not statistically significant at 3 months. The mean magnitude of SIA was 0.77 + 0.63 in Group I, versus 0.48 + 0.42 in Group II (p=0.13, Mann Whitney Test). The mean axis of SIA was 105.9 + 55.52 and 88.15 + 44.32 in Groups I and II respectively (p= 0.13, Mann Whitney Test).

Anterior Segment OCT – Incision Morphology
The qualitative incision morphologic features in both groups on anterior segment OCT.

Localized Descemet’s Membrane Detachment
There was no statistically significant difference in the incidence of localized Descemet’s detachment (DD) at 1 day, 1 week or 1 month follow-up. More number of eyes had localized DD in group II as compared to group I on day 1
and week 1. This difference, however, was not statistically significant. At the end of 1 month, 5 eyes in group I still had localized DD at the incision site, whereas no eye in group II had a persistent DD.

**Endothelial Gaping or Misalignment**

Significantly more number of eyes had gaping / misalignment of endothelium on day 1 and week 1 in group I as compared to group II. 24% eyes in group I showed endothelial wound gape on day 1, as compared to 8% eyes in group II.

**Epithelial Gaping**

Epithelial gaps were seen in 9 eyes in group I on day 1. At 1 week, none of the eyes in either group showed any gaps in the epithelium.

There were no significant differences in the corneal thickness 1mm temporal to the incision or the angle of incision at day 1 and week 1 between the groups. However, the incision site thickness was found to be slightly greater in Group II as compared to Group I.

**Anterior Segment Inflammation**

Eyes having cells and flare greater than grade 2 on slit lamp were compared and were found to be similar between the two groups.

**Corneal Endothelial Morphology**

3 months postoperatively, the endothelial cell loss was comparable between the groups. However, there was a significantly greater increase in coefficient of variation following surgery through a 1.8mm incision (P=0.03).

**Central Corneal Thickness (CCT)**

The percentage change in CCT over time. The difference in the rate of change in CCT was not statistically significant between the 2 groups from pre-operatively to 1 day, 1 week and 1 month postoperatively (P>05).

**Corneal Clarity**

Corneal clarity, as assessed on the slit lamp was comparable between the two groups at day 1, week 1 and 1 month (P>0.05). Although not statistically significant, only 80% eyes in Group I had clear corneas, as compared to 89% in Group II (p=0.23) postoperative day 1. 1 week postoperatively, 83% eyes in Group I had clear corneas compared to 94% in Group II (p=0.28).

Unaided visual acuity on day 1 and best corrected visual acuity at 3 months were comparable between the groups.

**DISCUSSION**

The quality of the clear corneal incision has a great impact on the outcomes following cataract surgery. The results of our study highlight the fact that although small incisions are beneficial in phacoemulsification\textsuperscript{1,2} maintaining...
wound integrity and minimizing wound distortion is the key to secure, self-sealing incisions. Often, there is clinically undetectable stretching and distortion of incisions, particularly due to manipulation with the phaco probe, and IOL implantation through a tight incision. In our study, incision enlargement was significantly greater in the 1.8mm incision group as compared to 2.2mm group. This finding is similar to that reported by other authors. Further, similar to what Lee and colleagues reported, we found that this incision stretching was more between initial incision and end of phacoemulsification. Incision enlargement following IOL implantation was comparable between the groups. Interestingly, Luo et. al. found equal enlargement in the 1.8mm group, both after nucleus emulsification and after IOL implantation.

In a previous experimental trial (“Histomorphological and Immunofluorescence evaluation of Clear Corneal Incisions following Microcoaxial phacoemulsification performed through 1.8 and 2.2mm: Randomized, Experimental trial”, paper presentation at the Annual Meeting of ASCRS 2011, San Diego) evaluating histomorphological features of the incision in rabbit eyes, we found that when phacoemulsification was performed through a 1.8mm incision system, there was a greater incidence of longitudinal splits in the collagen stroma with stromal irregularity, which increased following IOL implantation. This subclinical collagen damage may affect the integrity and self-sealing property of the incision.

On AS-OCT, there was a greater incidence of both endothelial gapping and misalignment in Group I, both on postoperative day 1 and week 1. This finding is similar to that reported by Luo et. al. who reported wound gape on endothelial side in 90% eyes with the 1.8mm incision, compared to 75% eyes with the 2.2mm incision. OCT architectural features of endothelial gapping and loss of coaptation theoretically reduce CCI structural integrity in the immediate postoperative period. These features could represent significant risk factors for endophthalmitis.

Reducing surgically induced astigmatism (SIA) is one of the challenges for cataract surgeons, in order to deliver excellent unaided vision postoperatively. Induced SIA was lesser when performing phacoemulsification through the 2.2mm incision system as compared to the 1.8mm system, although not to a statistically significant degree. SIA is dependent on several variables, including size of incision, location of incision, and the distortion and healing of the incision. Therefore, although smaller incisions would be expected to cause lower degrees of SIA, this is not always true. It is equally important to factor in the effect of surgical maneuvers on the incision.

There was no difference in the change of CCT, or endothelial cell density in both groups. However, the percentage change in coefficient of variation
was significantly greater in the Group I, suggestive of greater endothelial cell function damage. Lee et. al.\textsuperscript{5} reported greater endothelial cell loss with a 1.8mm system compared to a 2.2mm system.

Our study findings are similar to previous studies\textsuperscript{5,10,13,14} which suggest that using smaller and smaller incisions during phacoemulsification may sometimes actually increase the difficulty of surgery without improving clinical results. For incision sizes to go smaller and smaller during cataract surgery, it is important to have phaco tips, sleeves and IOL delivery systems which allow phacoemulsification with minimal damage to the incision, thereby ensuring a self sealing incision, and reducing the potential for endophthalmitis.

In a nutshell, this study compares two popularly used platforms for microcoaxial phacoemulsification. The knives, the phaco handpiece and ultrasound modalities were suited to each system but were different. Although both groups had IOL injection using a plunger-type injector, these injectors and cartridges were differently designed. Therefore, the differences we found in trypan ingress and incision enlargement cannot be attributed to the differences in the initial incision size alone, but, to multiple variables, including differences in energy delivery modalities, variability in the amount of stromal hydration performed and individual incision lengths apart from the above-mentioned variables. The study, therefore, provides a comparison of the two systems as they are being used today by surgeons worldwide. Both systems were found to be equally efficacious in terms of postoperative outcomes during emulsification of age-related cataracts.

In conclusion, at the end of the surgery, it is the distortion of the incision during surgery that determines the integrity of the clear corneal incision.

This reiterates the fact that when using smaller and smaller incisions during cataract surgery, there is always the risk of causing subclinical collagen damage (mechanical and thermal) which can jeopardize incision integrity.

REFERENCES
Evaluation of Phacodepth Required to Achieve Full Thickness Nuclear Crack in Various Grades of Cataract and to Determine Correlation Between the two: A one Year Observational Study

Dr. Praveen Malik, Dr. Taru Dewan, Dr. Jayanti Kashyap, Dr. Anshu Anind

Today phacoemulsification is the state of art technique. Since the introduction of Nagahara chop in 1993 the chopping techniques have remained a standard method of nuclear management. However the onus lies on surgeon to effectively and safely utilize them. Phacochop has been categorized as either horizontal or vertical.¹ These approaches are thought to be among the best techniques for managing hard cataracts.² In vertical chop technique proper placement of the phaco tip is crucial. It must be embedded deeply into the centre of the nucleus, pointing toward the optic nerve³, aided by settings like high vacuum and burst mode. For an effective vertical chop an adequate penetration of the phacotip to get a good purchase of lens nucleus
is essential as hesitancy can lead to residual posterior plate and overzealous penetration can lead to posterior capsule rent. This may be avoided if some estimate can be made pre-operatively of the depth of penetration required to achieve full thickness crack. However so far this assessment is purely subjective as no such tool to measure phacotip penetration is available. We can scientifically predict pre-operatively a safe and effective depth of penetration required by a phacotip on following basis. The human crystalline lens can be made to approximate an ellipsoid with diameter as the major axis and lens thickness as the minor axis. An arc gives the distance from the centre of upper surface to the point of entry of phacotip. We can calculate the length of radius from this point as the required depth to reach the core. This radius increases in a larger diameter lens, a thicker lens or in cases with entry point further away from the centre of anterior surface. Adult human crystalline lens varies in thickness from 4.2+/-0.5mm and has a diameter of 9.6+/-0.4mm. Assuming the lens diameter (b) to vary from 9.2 to 10mm, the lens thickness (a) varying from 3.7mm to 4.7mm and the point of entry of phacotip 2.0mm to 3.0mm from centre of anterior lens surface (y), this distance (x) would vary from 2.54 to 3.2 mm according to online wolfram calculator. This would be increased with increase in (a) as well as (y). In cataractous lens the harder a nucleus, the deeper it may be required to penetrate to reach beyond the anatomical centre for an effective chop. With this in mind we designed SRF -CMP 1 a calibrated phacotip with 4 etched bands to serve as a measuring tool. Once preoperatively calculated it not only marks the entry point on lens surface the calibrated tip also measures as it reaches the desired depth when a vertical chop can be effectively and safely executed which we thus call a calibchop. The main aim of this study was to observe phacodepth required in cases of nuclear cataract for a safe and effective vertical chop based on preoperative nuclear grading, and thus be able to add objectivity to a so far subjective assessment.

**MATERIALS AND METHODS**

This observational cross sectional study comprised patients more than 40 years of age with cataract who were consecutively recruited for cataract surgery between 1st Nov 2010 to 1st Nov 2011. All patients signed an informed consent form before surgery and the study was approved by the local ethics
committee. Inclusion criteria were visually significant cataract in patients > 40 years of age with grade (3.0 to 6.9) cataract according to the LOCS-III classification. Patients with subluxated and dislocated lens, any central leucomatous corneal opacity which prevented visualization of cataractous lens for grading and surgery and any systemic contraindication for surgery were excluded from the study. Detailed preoperative assessment was done in all cases. Cataract was graded according to the LOCS-III classification. A note was made of the axial length and lens thickness in each case. Clear corneal coaxial phacoemulsification surgeries was performed under topical anaesthesia in all patients by the one of the two surgeon. After a clear corneal incision the distance between the centre of anterior lens surface and point of entry of phacotip was measured using the calibrated tip as a scale which was kept constant at 2.4mm in each case. The sleeve was retracted enough to enable visualization of markings but at the same time prevent irrigation into the incision tunnel. After hydrolineation and nuclear rotation the nucleus was impaled using the phacotip and vertical chop attempted using a fine pointed 1mm chopper in all cases. In event of incomplete crack the nucleus was rotated and tip further advanced and chop attempted. A note was made of the depth at which full thickness crack was achieved. Any occurrence of posterior capsular rupture was noted. Phacoemulsification was completed and IOL inserted. Standard postoperative care regime was followed. The phacodepth was considered safe if no posterior capsular rupture occurred and effective if a complete nuclear crack was achieved. Both the criteria had to be met to call it safe and effective vertical chop.

Statistical Analysis
Statistical analysis was performed using statistical analysis formulas with Microsoft excel. All data was reported as mean +/- sd. Pearson correlation coefficient was calculated to find any association between the predictor and outcome variables.

RESULTS
The study evaluated 200 eyes of 200 patients. The mean age of 111 women (55.5%) and 89 men (44.5%) was 62.7±10.36 year. The study population had a mean age of 62.7±10.36 year, mean lens thickness of 3.98±0.51mm, mean nuclear opalescence of 4.67±1.21, mean nuclear color of 4.76±1.22 and mean phacodepth of 2.57±0.18mm. Using Pearsons Correlation coefficient the correlation between lens thickness and phacodepth was not statistically significant (r=0.1111) however a strong positive correlation was observed between Nuclear Opalescence and phacodepth (r=0.8426) as well as between nuclear color and phacodepth (r=0.8473) which were highly significant statistically.

There were no cases of posterior capsule rupture during the study.
DISCUSSION

The observations made in this study showed that there was a highly positive correlation between nuclear color and phacodepth and nuclear opalescence and phacodepth indicating that harder nuclei warranted deeper penetration of the phacotip. After further statistical analysis we found that the approximate average phacodepth required was 2.8mm in grades 6.0 to 6.9, 2.6mm in grades 4.5 to 5.9 and 2.4mm in grades 2.0 to 4.4 for both nuclear color and nuclear opalescence according to the LOCS III classification. Thus a normogram can be made to recommend the anticipated depth required to achieve a safe and effective vertical chop. To conclude the calibrated phacotip would help us in predicting a safe and effective phacodepth in various grades of cataract by which we can avoid complications of vertical phaco chop like residual posterior plate and posterior capsular rent thus increasing the success rate of phaco chop in denser cataract. This would further help us in making phaco chop a safe, effective and reproducible technique.

Intracameral Moxifloxacin – “I thought it may be of Some use but was Amazed at the End”

Dr. Ravi Tripathi, Dr. Ravi Chandil, Dr. Pooja Shukla

Endophthalmitis is still major concern after ocular surgery with incidence varying from 0.04% to 0.4% worldwide. Despite the use of povidone iodine and prophylactic topical antibiotic incidence still increased during 1994-2001 in Europe. There are various causes due to which endophthalmitis develop after ocular surgery but several studies shows that the most common source of infection is inhabitant microbial flora of conjunctiva and periocular tissue. Although povidone iodine with topical antibiotic is recommended prophylactic method but studies are available which shows its sterilization efficacy is up to 83% eye. Mode of inoculation is usually intraoperative entry during surgery through the contaminated instrument, contaminated irrigation fluid or postoperative entry, if wound is not properly sealed.

To combat this intraoperative inoculation various studies suggest the role of intracameral antibiotics. Results of these studies have shown significant reduction in endophthalmitis after prophylactic intracameral antibiotic instillation.

But, all these studies were conducted in hospitals where patient belonged to high socioeconomic status and were literate while to the best of our knowledge no clinical data or studies are available which shows reduction in endophthalmitis after intracameral moxifloxacin use, in high volume
surgery hospital where patient has poor hygiene and are illiterate. Moreover in these studies results were usually compared with literature or data from the other setting so they don’t give strong evidence of reduced incidence of endophthalmitis in same setting.

The aim of this study was to assess the effect of prophylactic intracameral moxifloxacin on incidence of endophthalmitis in high volume surgery setup.

**MATERIALS AND METHODS**

This was a retrospective analysis of 5040 case sheets of all types of cataract surgery operated from May 2010 to April 2012. In this study inclusion criteria were uncomplicated and complicated cataract surgeries both, combined cataract and trabeculectomy and high risk cases those are vulnerable to infection *i.e.* lacrimal passage block cases with clear water regurgitation. Only exclusion criteria was patient who didn’t completed their 1 month follow up.

All surgeries were done by single surgeon and at single site. Operating method were SICS, phacoemulsification and combined SICS + trabeculectomy. Patient were divided into 2 two groups, group 1 which didn’t received intracameral moxifloxacin at the end of surgery and group 2 which received prophylactic intracameral moxifloxacin at the end of surgery. Method of injection was simple, 0.5% moxifloxacin was taken in to tuberculin syringe by 26 gauge needle, directly from commercially available bottle, then 0.1 ml or 4 units of drug injected into capsular bag through 27g cannula at the conclusion of the surgery via sideport incision ,then wound is further rehydrated for tight closure.

Both the groups were divided in subgroups for further comparison; A) Uncomplicated cataract B) combined cataract +trabeculectomy cases, C) Complicated cataract or difficult cases D) cases having lacrimal passage block with clear water regurgitation on syringing.

Evaluation criteria’s were 1) Incidence of endophthalmitis 2) Corneal status 3) Anterior chamber reaction. Endophthalmitis was diagnosed by anterior chamber reaction with vitritis obscuring secondary retinal vessels along with pain and congestion. Corneal status was determined by corneal oedema with descemets fold >5 at center of cornea and anterior chamber reaction evaluated by grading of cells and flare based on Hogan’s criteria.

**RESULTS**

6 cases of endophthalmitis were reported in group 1 out of 2630 patient (Table 1) who didn’t received intracameral moxifloxacin while out of 2410 patient of group 2 (Table 1) which received intracameral moxifloxacin, no endophthalmitis found.
Table 1: Patient distribution

<table>
<thead>
<tr>
<th>Total patient</th>
<th>Sub group A</th>
<th>Sub group B</th>
<th>Sub group C</th>
<th>Sub group D</th>
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<tbody>
<tr>
<td>Group 1</td>
<td>2630</td>
<td>2304</td>
<td>144</td>
<td>72</td>
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<tr>
<td>Group 2</td>
<td>2410</td>
<td>2100</td>
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<tr>
<td>Total</td>
<td>5040</td>
<td>4404</td>
<td>278</td>
<td>152</td>
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Table 2: Percentage of patients with Corneal Oedema and SK on 1st, 7th and 30th post operative day

<table>
<thead>
<tr>
<th>Uncomplicated cataract</th>
<th>Day 1</th>
<th>Day 7</th>
<th>Day 30</th>
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<tbody>
<tr>
<td>Group 1</td>
<td>11</td>
<td>6</td>
<td>0.1</td>
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<tr>
<td>Group 2</td>
<td>15</td>
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<td>0</td>
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<tr>
<td>Cataract + trab</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Group 1</td>
<td>52</td>
<td>10.4</td>
<td>2.1</td>
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<tr>
<td>Group 2</td>
<td>65</td>
<td>11.94</td>
<td>2.2</td>
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<tr>
<td>Complicated cataract</td>
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<td></td>
<td></td>
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<tr>
<td>Group 1</td>
<td>69.5</td>
<td>36</td>
<td>5.5</td>
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<tr>
<td>Group 2</td>
<td>81.2</td>
<td>42</td>
<td>5</td>
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<td>Passage block cases</td>
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<tr>
<td>Group 1</td>
<td>30</td>
<td>11</td>
<td>0.2</td>
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<tr>
<td>Group 2</td>
<td>32</td>
<td>12.6</td>
<td>0.2</td>
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Table 3: Percentage of patients with Anterior Chamber Reaction on first post operative day

<table>
<thead>
<tr>
<th>Ant chamber reaction</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Trace</td>
<td>15</td>
<td>0.0</td>
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<tr>
<td>Grade 1</td>
<td>47.5</td>
<td>17.7</td>
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<tr>
<td>Grade 2</td>
<td>37</td>
<td>73.7</td>
</tr>
<tr>
<td>Grade 3</td>
<td>0.47</td>
<td>8.4</td>
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</table>

Table 4: Percentage of patients with Anterior Chamber Reaction on 7th post operative day

<table>
<thead>
<tr>
<th>Ant chamber reaction</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
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<tr>
<td>Trace</td>
<td>73.6</td>
<td>23</td>
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<tr>
<td>Grade 1</td>
<td>26.4</td>
<td>73.6</td>
</tr>
<tr>
<td>Grade 2</td>
<td>0.0</td>
<td>3.4</td>
</tr>
<tr>
<td>Grade 3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
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</table>

There was significant reduction in incidence of endophthalmitis in group 2 (0%) in comparison to group 1 (0.23%). All the 6 reported cases belong to
uncomplicated subgroup (A) of group 1, and presented after 10th postoperative day. Out of 6 patients, 4 patients were managed in the same hospital with core vitrectomy and intravitreal antibiotics, 2 were found to be positive for gram positive cocci in vitreous aspirates. Subgroup analysis on 1st postoperative day shows, slight higher corneal edema and striate keratopathy in all the subgroups of group 2 in comparison to subgroups of group 1, while almost same percentage of patient have corneal oedema on 7th postoperative day and 30th postoperative day in both the groups (Table 2). Anterior chamber reaction was slight higher in all the subgroups of group 2 in comparison to group 1 on first postoperative day, almost similar reaction was observed in both the groups on 7th and 30th postoperative day. (Table 3 and Table 4).

**DISCUSSION**

Endophthalmitis is usually caused by inhabitant microbial flora of conjunctiva and periocular tissue which most probably enters during the surgery. To prevent this inoculation most commonly used antibiotics are cefuroxime, vancomycin and moxifloxacín. Cefuroxime and vancomycin commonly used in Europe and U.S., respectively. But both these have time dependent killing property and requires reconstitution before use so there are increased chances of contamination and TASS. Because of the risk to emergence of resistant bacteria American academy discourages the use of prophylactic vancomycin. Axer-siegel et. al. also shows increased risk of cystoid macular edema after use of intracameral vancomycin. Although intracameral use of cefuroxime shows significant reduction in endophthalmitis in ESCR Study but its efficacy to gram negative bacteria time dependent curve, reconstitution before use, makes its choice questionable. Our choice was intracameral moxifloxacin because it doesn’t require reconstitution before surgery, its osmolality 290m Osm/kg and pH 6.8 is compatible with human eye thus reducing the chances of TASS. Moxifloxacin has lowest mean inhibitory concentration dose for commonest microbes causing endophthalmitis, its concentration remain above the MIC up to 5 hr. Moxifloxacin has broad spectrum activity against gram positive, gram negative bacteria and atypical mycobacterium as well as anaerobes.

We have achieved zero incidences of endophthalmitis with intracameral moxifloxacin. Our findings consolidate the view that use of intracameral antibiotics decreases the rate of endophthalmitis. Moreover the incidence of endophthalmitis reported were higher in high volume surgery or where patient belongs to low socioeconomic status than with low volume surgery. Our results were similar to previous studies which show anterior chamber
reaction and corneal edema were similar on 7th and 30th postoperative day in both groups.17,18

On the basis of above results, we can conclude that intracameral moxifloxacin significantly reduces the incidence of endophthalmitis even in high volume surgery. Further studies are to needed to establish it as a routine prophylactic measure in high volume surgeries.

REFERENCES


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**Femtosecond Laser Refractive Cataract Surgery – Use in More Difficult Cases**

**Dr. Kasu Prasad Reddy**

The advent of femtosecond-laser cataract surgery (FRCS) has gained significant attention within the ophthalmic community in the past few years. This new technique offers the potential to improve the accuracy and the reproducibility of the anterior capsulotomy compared with the manual procedure, reduce the energy required for lens fragmentation, provide accurate and precise corneal incisions, improve the predictability of IOL placement and potentially improve outcomes.

A number of femtosecond laser systems are now available on the market. Our practice opted to install the VICTUS Femtosecond Laser Platform (Technolas Perfect Vision/Bausch+Lomb) owing to the versatility of the system which can perform cataract procedures, as well as LASIK flaps and therapeutic procedures such as ICRS and PKP. The laser features a curved patient interface and Intelligent Pressure sensors which reduces corneal deformation. In addition, the system has a user-friendly, graphic user interface with real-time OCT for procedural planning and monitoring.

Our own experience using the VICTUS Femtosecond Laser Platform in routine cases has found the FRCS technique provides a statistically significant improvement in the circularity and centration of the anterior capsulotomy compared with the manual technique, as well as excellent accuracy and predictability of the capsulotomy diameter.¹ The VICTUS femtosecond laser has been effectively used to fragment the lens in all cataract grades 1 to 5, with a reduction in the effective phaco time (EPT) for all grades. In over 750
procedures performed at our clinic in Hyderabad, the FRCS technique has been safely and effectively used in all cases.

After first gaining experience in using the VICTUS laser for routine cataract cases, we conducted a study whereby patients with more challenging cataract cases were selected to undergo the femto-cataract technique. These challenging cases included dark brown grade 5 cataract, calcified cataract, white intumescent cataract, subluxated cataract, posterior polar cataract, traumatic cataract and paediatric cases (performed under general anaesthetic). In all cases, it was the surgeon’s opinion that the patient would benefit from undergoing the anterior capsulotomy with the femto-cataract procedure as opposed to the standard manual capsulorhexis technique. The measured parameters included safety, efficacy and precision of the capsulotomy. Following the femto-cataract surgery with the VICTUS platform, phaco was performed with the Stellaris system (B+L).

RESULTS
In the Dark brown grade 5 cataracts larger capsulotomy of 6.5mm was done and is very accurate in Diameter, circularity and centration, like any other usual cataracts that were done and the fragmentation the time taken is the same and helped with the effective phaco time and safety of phacoemulsification.

In the calcified cataract the calcified capsular thickening was noticed to be of very high grade and is not possible to do with a forceps or a cystotome and Femtocapsulotomy was found to be most successful.

In all the other difficult situations like the subluxated, posterior polar, traumatic and paediatric cases Femtocapsulotomy was very accurate and useful.

All the complicated cataract cases were safely performed with the femto-cataract procedure. All procedures were uneventful. The accuracy in the diameter, circularity and centration of the capsulotomy was beneficial in these cases. Careful docking was always critical but surgeon friendly with the Victus. The microscope on the VICTUS system was particularly helpful for the complicated cases on paediatric patients under general anaesthetic. As the anterior capsulotomy procedure takes around 10 seconds with the femtosecond laser, the FRCS can also save time in more challenging cases.

In my opinion as conclusion, it has been beneficial to use of the femto-cataract technique in more challenging cases where it may be advantageous to produce precise anterior capsulotomies and fragmentation of your choice ie 4, 6 or 8 quadrants or circles in the lens matter.

REFERENCE
Phacoemulsification has been accepted as a standard of care for cataract treatment in developed countries. It is practised routinely in standard and difficult cataracts, and is a preferred option for implanting newer generation IOLs. With changing times there is a trend towards reducing the incision size in order to reduce the surgically induce astigmatism. Manual small incision cataract surgery (SICS) is an alternative modality for cataract removal. There are few studies evaluating SICS and phacoemulsification in literature. The main cited advantage of this procedure is its short term cost effectiveness, less technology dependant and short surgical duration. The disadvantages of this technique include low uncorrected visual acuity, and high induced astigmatism, when compared to phacoemulsification which limits the visual outcomes.

Uncorrected visual acuity is important for everyday ambulatory vision as most of the patients do not prefer to use glasses and rely on uncorrected vision. In the past decade SICS technique has provided visual rehabilitation in developing nations in large volume surgeries. In these studies the impact of this visual outcomes (uncorrected visual acuity) on functional visual performance has been addressed only modestly. To address this question we thus designed this study to primarily compare the uncorrected visual acuity postoperatively between phacoemulsification and SICS.

MATERIALS AND METHODS
This study is a multi-centric, prospective, randomised, masked, study. The study was conducted according to International conference on Harmonisation-Good Clinical Practice guidelines and ethical principles laid down in the declaration of Helsinki. All the study patients were recruited after study was approved by the institute’s ethics committee board. Informed consent was taken from all patients before participation in the study. This study was done at two centres in different states of India - S. K. Red Cross Eye hospital, Dholka town, Gujarat affiliated to Iladevi Cataract and IOL Research Center, Ahmedabad and Arvind Eye hospital, Madurai, Tamil Nadu, India. The inclusion criteria was bilateral uncomplicated senile cataract, undergoing surgery for the first eye, nuclear opacity of grade 2 or above, willingness to randomly receive IOL implantation, pupil dilation equal or greater to 7 mm after mydriasis, visual prognosis equal or greater to 6/9. The following exclusion criteria were applied: adults younger
than 55 years of age, nuclear sclerosis greater than grade 4 (LOCS OR Emery), mature or hypermature cataracts, keratometric astigmatism of > 1.5 diopters, axial myopia greater than 25.5 mm, coexisting ocular pathology, un-dilating pupil, traumatic cataracts or operated eyes, not willing for regular follow up, systemic steroids and non steroidal anti-inflammatory drugs and any patients with significant intra-operative complications.

The recruited patients underwent preoperative examination by the same examiner on slit lamp bio-microscopy to classify cataract and grade nuclear opacity with the Emery’s Lens Opacities Classification System; examination of the retina; measurement of intraocular pressure (IOP); subjective refraction, measurement of uncorrected distance visual acuity (UDVA) using the ETDRS chart (Vector vision acuity chart at 100% contrast); evaluation of astigmatism by manual keratometry (Topcon OM-4 Ophthalmometer, Topcon Medical Systems, USA); measurement of axial length using the immersion ultrasound ( Alcon); corrected distance visual acuity (CDVA) using the ETDRS chart. Absolute values of log CSF for each spatial frequency were obtained for each eye and means and standard deviations were calculated.

The surgeries were performed by a single surgeon at both the centers who had good surgical experience and were conversant with both the surgical techniques. Manual small incision cataract surgery (M-SICS) was done under peribulbar anaesthesia. A superior scleral tunnel incision of 7 mm. Was done, the anterior chamber was filled with hydroxypropyl methycellulose (HPMC) viscoelatic and anterior continuous curvilinear capsulorhexis, cortical cleaving hydrodissection and hydrodelineation were performed. A blumenthal’s anterior chamber maintainer was inserted into the anterior chamber. The nucleus was then prolapsed into the anterior chamber and visco-expressed along with the epinucleus. The cortex was manually aspirated using the simcoe’s cannula. A single piece PMMA IOL (model MZ60BD, 6 mm optic and 13 mm overall diameter, Aurolab laboratories, Maduarai, India) was implanted in the bag using the McPhersons’ forceps.

Co-axial micro-incision cataract surgery (PHACO) was done under topical anesthesia. A 2.2 mm (Alcon Laboratories, Forth Worth, Texas) single plane temporal clear corneal tunnel was fashioned. An ACCC and hydrodissection were done. Micro Coaxial Phacoemulsification (MCP) was performed with a 0.9 mm Mini-flare ABS 45° Kelman Tip and an ultrasleeve on the Infiniti Vision System (Alcon Laboratories, Fort Worth, USA). Without enlarging the incision, an AcrySof Natural IQ IOL (model SN60WF, 6mm optic diameter and 13 mm overall diameter, Alcon Laboratories, Fort worth, USA) was implanted in the bag with a “C” cartridge through the Monarch shooter. In both techniques the wound integrity was checked by applying the fluorescent strips at the incision. Dilution of the dye with the flow of aqueous through the incision was noted.
The external incision was sutured if a leak was noted. If no leak was noted, the main incision as well as the paracentesis was hydrated. The postoperative regime was standardised in both groups.

Both eyes were examined at day 1, 2 weeks, 1, 3, 6 and 12 months. Only first eye of each individual undergoing cataract surgery at each centre was randomized to receive the two options. The randomization and allocation was conducted in similar manner at both centres. The surgeon was masked to the surgical procedure until just prior to cataract surgery in the operating theatre. The patients were masked to the type of surgical intervention they underwent. The principal investigator and the examiner technician who evaluated the visual acuity, contrast sensitivity, refraction, subjective correction, keratometry were unaware of the allocation. The examiner ophthalmologist who evaluated the eye for corneal clarity, anterior chamber reaction was not made aware of the study objective as he would be able to determine the allocation.

All numerical and graphical evaluations were performed by an independent statistician by means of SPSS (release 10.0 for Windows). We used non-parametric Mann–Whitney test because our quantitative variables were not found to be normally distributed for comparison between two surgical approaches. For categorical data we used the chi-square test and test of proportion.

**RESULTS**

The number of males: females in phaco group (n=140) is 67:73 and 71:70 in SICS group, p= 0.8 (test of proportion); the mean age in years was 58 ± 8.9 in phaco group and 56 ± 7.86 in SICS group, p=0.74 (independent t-test); The median UDVA in LogMAR was 1.0 (0 to 1.6) in phaco group and 1.0 (0.3 to 1.6) in SICS group, p=0.74 (Mann whitney test). There were equal proportion of eyes with grades 2, 3 and 4 between the two groups, test of proportion, p=0.7, 0.8, 0.7 respectively (test of proportion). There was no deviation in the protocol in any groups.

**Visual acuity**

Table 1 demonstrates the median LogMar values at different time points in both the groups. The values remained statistically higher in the phaco group at all post-operative examination time points. Table 2 charts the uncorrected distance visual acuity (UDVA) in the two groups at different post-operative time points. Table 3 demonstrates the median LogMar values at different time points in both the groups. The values remained statistically similar between the group’s at all post-operative examination time points. With correction no statistically significant differences were found between the Phaco and SICS groups at any time points.
**Low contrast sensitivity**

Table 4 compares the low contrast sensitivity with distance correction at 3 and 12 months follow up between Phaco and SICS at different time points. Statistically significant difference was noted between the groups regarding photopic contrast sensitivity aided at 3 months at only 18 cpd. No significant difference was noted at mesopic testing at 3 months. Statistically significant difference was noted for photopic and mesopic testing aided for 3, 6, 12 and 18 cpd at 12 months.

**Anterior chamber cells**

Tables 5 compare the proportion of eyes with cells and flare in two groups at different follow up visits. Anterior chamber cell reaction differs significantly between the groups on 1st post operative day (p=.000), on postoperative day 15 (p=0.000) and 1 month (0.001). Grade-1 of AC reaction was seen till 1 month follow-up in phaco group and then AC reaction subsided on subsequent follow-ups. In SICS group, cells upto grade-3 were noted on 15 days follow-up. AC cells of grade-1 remained persistent on 1st and 3 month follow-up. The difference in severity of reaction was not statistically significant between the groups at 3, 6 and 12 months follow-up.

**Vectorial Astigmatism Analysis**

SIA calculated by vectorial analysis showed that in the phaco group a mean vectorial astigmatic change in magnitude was 0.74±0.46 compared with 1.37±1.09 D in the SICS group (P=0.01, Mann whitney test).

**DISCUSSION**

To the authors knowledge this is the first prospective randomized trial conducted at two different centres comparing visual functional performance between Phacoemulsification and manual small incision cataract surgery.

<table>
<thead>
<tr>
<th>Table 1: Median uncorrected distance visual acuity (UDVA) in Log MAR in the two groups at different time points</th>
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</thead>
<tbody>
<tr>
<td><strong>Phacoemulsification</strong></td>
</tr>
<tr>
<td>Preoperative</td>
</tr>
<tr>
<td>Post-operative 1ST day</td>
</tr>
<tr>
<td>Post-operative 15 day</td>
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<td>Post-operative 1 month</td>
</tr>
<tr>
<td>Post-operative 3 months</td>
</tr>
<tr>
<td>Post-operative 6 months</td>
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<tr>
<td>Post-operative 12 months</td>
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* = P Value of Mann-Whitney U Comparing 2 Groups
<table>
<thead>
<tr>
<th></th>
<th>≥ 6/6 N (%)</th>
<th>6/9 N (%)</th>
<th>6/12 N (%)</th>
<th>6/18 N (%)</th>
<th>6/24 N (%)</th>
<th>6/36 N (%)</th>
<th>6/60 N (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st day Phaco (N=136)</td>
<td>28 (20.58)</td>
<td>34(25.0)</td>
<td>45(33.08)</td>
<td>19(13.97)</td>
<td>8(5.88)</td>
<td>1(0.73)</td>
<td>1(0.73)</td>
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<td>SICS (N=134)</td>
<td>18(13.43)</td>
<td>25(18.65)</td>
<td>34(25.37)</td>
<td>25(18.65)</td>
<td>24(17.91)</td>
<td>6(4.47)</td>
<td>2(1.49)</td>
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<td>15 days Phaco (N=135)</td>
<td>30 (22.22)</td>
<td>38 (28.15)</td>
<td>49 (36.30)</td>
<td>14 (10.37)</td>
<td>2 (1.48)</td>
<td>2 (1.48)</td>
<td>0 (0.00)</td>
<td>0.00</td>
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<tr>
<td>SICS (N=132)</td>
<td>21(15.91)</td>
<td>27(20.45)</td>
<td>37(28.03)</td>
<td>20(15.15)</td>
<td>14(10.61)</td>
<td>10(7.58)</td>
<td>3(2.27)</td>
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<tr>
<td>1 months Phaco (N=135)</td>
<td>45(33.33)</td>
<td>40(29)</td>
<td>33(24.44)</td>
<td>11(8.14)</td>
<td>3(2.22)</td>
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<td>24 (18.18)</td>
<td>26(19.70)</td>
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<td>18(13.64)</td>
<td>16(12.12)</td>
<td>6 (4.55)</td>
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<td>3 months Phaco (N=135)</td>
<td>50(37.04)</td>
<td>26(19.26)</td>
<td>32(23.70)</td>
<td>15(11.11)</td>
<td>8(5.93)</td>
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<td>24(18.32)</td>
<td>28(21.37)</td>
<td>36(27.48)</td>
<td>21(16.03)</td>
<td>11(8.45)</td>
<td>6(4.58)</td>
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<td>6 months Phaco (N=133)</td>
<td>47 (35.34)</td>
<td>25 (18.80)</td>
<td>40 (30.08)</td>
<td>10 (7.52)</td>
<td>9 (6.77)</td>
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<td>25 (19.38)</td>
<td>25 (19.38)</td>
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<td>11 (8.53)</td>
<td>2 (1.55)</td>
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<tr>
<td>12 months Phaco (N=132)</td>
<td>49 (37.12)</td>
<td>24 (18.18)</td>
<td>40 (30.30)</td>
<td>10 (7.58)</td>
<td>7 (5.30)</td>
<td>1 (0.76)</td>
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<td>SICS (N=122)</td>
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<td>40 (32.79)</td>
<td>17 (13.93)</td>
<td>12 (9.84)</td>
<td>5 (4.10)</td>
<td>0 (0.00)</td>
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</table>

P value = chisquare test
Visual acuity: In the present study visual acuity assessment differs from existing trials comparing phaco versus SICS. First we compared the groups based on post-operative visual acuity of 20/30 (6/9) or better. Secondly we sought to determine when it was first achieved in temporal profile and third we observed for how long it remained stable until the last follow-up at different time points.

Visual acuity has been compared at a cut-off of 20/60 (6/18) in previous clinical trials that sought to evaluate surgical outcomes between Phaco and SICS. While recent studies evaluating phaco outcomes have compared at a cut-off based on 20/40 or better. We believe that the cut-off value of visual acuity for comparing phaco versus SICS should be raised from 6/18 to 6/9 as uncorrected refractive error is a common cause of poor outcome following cataract surgery in developing countries. The cost of glasses standard practice and, in some countries, the lack of expertise to prescribe and manufacture high quality spectacles, limits their use. Uncorrected visual acuity is a major reason for falls and injuries in older populations. If we compare the visual gain between the two techniques at a cut-off of 20/30 (6/9) or better it is interesting to note that our results concur with previous studies. Ruit et. al. reported 20/30 (6/9) or better in 54% eyes in phaco group versus 32% eyes in SICS group. Gogate et. al. also reported 20/30 or better in 37% eyes in phaco group versus 32% eyes in SICS group. Vision of 20/30 of better was achieved in both groups from the 1st post-operative day, 45% in phaco group versus 32% in SICS group. A previous study reported better visual recovery of 20/30 in SICS as compared to Phaco on 1st post-operative day (50% versus 30%). They attribute this difference to more advanced cataracts in the phaco group. To avoid refractive surprises we were careful to exclude patients with extreme biometric data. Visual acuity improved until (l) month post-operative follow-up in both groups. It improved from 0.20 LogMAR to 0.10 LogMAR in Phaco group versus 0.3 logMAR to 0.20 logMAR in SICS group. The improvement was significantly higher in Phaco group. The vision remained stable in both groups in majority until the last

<table>
<thead>
<tr>
<th>Table 3: Median corrected distance visual acuity (CDVA) in Log MAR in the two groups at different time points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phacoemulsification</strong></td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>Preoperative</td>
</tr>
<tr>
<td>Post-operative 15 day</td>
</tr>
<tr>
<td>Post-operative 1 month</td>
</tr>
<tr>
<td>Post-operative 3 months</td>
</tr>
<tr>
<td>Post-operative 6 months</td>
</tr>
<tr>
<td>Post-operative 12 months</td>
</tr>
</tbody>
</table>

* = P Value of Mann-Whitney U Comparing 2 Groups
### Table 4: Comparison of low contrast sensitivity after distance correction at 3 and 12 months follow up between Phaco and SICS at different time points

<table>
<thead>
<tr>
<th></th>
<th>Aided Photopic (Log MAR means ± S.D.)</th>
<th>Aided Mesopic (Log MAR means ± S.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td><strong>3 months</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phaco (N=135)</td>
<td>Mean ± S.D.</td>
<td>1.61 ± 0.17</td>
</tr>
<tr>
<td>Median</td>
<td>1.63</td>
<td>1.84</td>
</tr>
<tr>
<td>SICS (N=131)</td>
<td>Mean ± S.D.</td>
<td>1.65 ± 0.47</td>
</tr>
<tr>
<td>Median</td>
<td>1.63</td>
<td>1.84</td>
</tr>
<tr>
<td><strong>P VALUE</strong>*</td>
<td>0.96</td>
<td>0.10</td>
</tr>
<tr>
<td><strong>12 months</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phaco (N=132)</td>
<td>Mean ± S.D.</td>
<td>1.61 ± 0.13</td>
</tr>
<tr>
<td>Median</td>
<td>1.63</td>
<td>1.84</td>
</tr>
<tr>
<td>SICS (N=122)</td>
<td>Mean ± S.D.</td>
<td>1.55 ± 0.17</td>
</tr>
<tr>
<td>Median</td>
<td>1.63</td>
<td>1.70</td>
</tr>
<tr>
<td><strong>P VALUE</strong>*</td>
<td>0.03</td>
<td>0.00</td>
</tr>
</tbody>
</table>

*P Value = Mann-Whitney test*
follow-up. In the present study we found that low inflammation, surgically induced astigmatism could be responsible for better uncorrected vision in the phaco group as compared to the SICS group.

CDVA was statistically similar with both techniques in the present study as well as in previous studies. The drop in the visual acuity at 3 months follow up in the SICS group is difficult to explain.
Low contrast sensitivity (CS) testing

We evaluated the low contrast sensitivity performance of the eyes in different illumination conditions in addition to observing high contrast visual acuity alone as the inference from the latter test is found to be unrelated to the improvement in day-to-day activities or self-reported visual function after cataract surgery. There was significant difference at 12 months after best correction in the CS performance at low and mild spatial frequencies in photopic and mesopic illumination probably because of the early development of posterior capsule opacification in the SICS group. Quantifying posterior capsule opacification using an objective evaluation software may have provided more relevant information. For our interest we also compared uncorrected contrast sensitivity and found that the performance was better in phaco group presumably because of low induced astigmatism in phaco as compared to SICS.

Inflammation

Since HPMC was used in both groups the differences in inflammation is unlikely to be due to the OVD used. Objective evaluation using a flare-cell meter was not possible in the given settings.

Astigmatism: In our study the significant difference in SIA between the groups may be explained by the differences in the incision size and the location. The astigmatism that is induced by the site and the size (7 mm) sclera tunnel could have played a role in some of the patient in the SICS group having low UCVA. Gogate et. al. also report a statistically similar change in astigmatism between the groups. Phaco group had lower degrees of astigmatism (ranging from 0 to 0.75 diopters) as compared to their SICS group; while their SICS group had higher degrees of astigmatism (ranging between 1 to 2.75 diopters) as compared to phaco group, 59.9% versus 48.6% respectively. The present study used vector analysis for measuring SIA.

The mean induced astigmatism of 1.4 diopters in our SICS group is similar to other reports who calculated SIA using dedicated formula’s. Hennig et. al. at report a mean induced cylinder of 1.41 D (SD 0.8). In their group there was a further small increase in against the rule astigmatism of 0.66 D (SD 0.41). Lam D et. al. report mean post-operative astigmatism of 1.13 ± 0.84 D. They used a temporal corneo-scleral incision for their SICS approach. The change in vector analysis after phaco in our group is comparable to results reported by Hayashi et. al. They report 0.55±0.52 at 5 years and 0.59 ± 0.52 at 10 years. Kurz S et. al. report a change in astigmatism of -0.31 dioptres with 2.75 mm phaco incisions. From the present data we comment on the impact of incision size on stability of the refraction between the two groups as we performed keratometry post-operatively at 3 months follow up.
Complications

The complication rate was negligible in both groups at both centers perhaps since the surgeons at both centers were experienced in handling both techniques equally well.

The strengths of this study are that a prospective randomised multi-centric trial was undertaken. To eliminate bias a stringent methodology was adapted at various stages of the trial, i.e. recruitment, intervention, observation and analysis. The limitations in this trial are that stability of refraction was not measured in the groups and anterior chamber reaction were measured subjectively.

In our study at all time points with phaco uncorrected distance high and low contrast sensitivity measurement in different illuminations at all spatial frequencies were significantly higher, surgically induced astigmatism was significantly lower, anterior chamber inflammation recovered more rapidly, relative to the M-SICS. Additional studies should be performed to confirm our results in various patient populations.

REFERENCES


Recognize both. Recommend AcrySof® IQ Toric IOL.


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**An Innovative and Simplified Technique of Axis Marking for Toric IOL Implantation**

**Dr. O P Agarwal**

After spherical errors, astigmatism remains the major cause of reduced UCVA post cataract surgery. It has been observed that 50% of total cataract patients have less than or equal to 0.5D astigmatism, 25% are in the range of 0.75 to 1.0D, 24% have 1.0D to 4.0D and 1% has more than 4.0D of astigmatism. Accurate biometry can help to reduce spherical errors, but for correcting astigmatism during surgery implantation of Toric IOL is the most precise and predictable way.

Toric IOL implantation require precise placement of IOL at desired calculated axis. Every 1 degree deviation in lens placement causes 3.3% loss the lens cylindrical power.

Axis marking for TORIC IOL is routinely done in 2 Steps.

**Step 1:** Reference marking and

**Step 2:** Axis marking for Incision location and IOL Placement.

Reference marking is done in sitting upright position with reference marker, where limbus is marked on 3 side at 3,6 and 9 O’clock. This 3 marks act as reference marks for final marking in second step on the OT table when patient is in lying down position (reference marking is done to avoid cyclo-torsional effect of eye). In second step with the help of Mendez ring, marking of cornea for, Incision location and 2 marks 180 degree apart for axis of placement is done with axis marker. So in this method total 6 marks are applied (3 reference marks, 1 incision location mark and 2 marks of axis of placement). This method is little cumbersome, error in reference marks (as there is no standardized way of reference marking) will reduplicate in second step of marking.

We have device an innovative and simplified technique of axis marking for toric IOL implantation. The purpose of this presentation is to demonstrate a simple and innovative method “OPAI TECHNIQUE” of axis marking for Toric IOL implantation, which will reduce chances of error in final placement of Toric IOL to desired pre-calculated axis.
MATERIALS AND METHODS

After the Toric IOL calculation was done online at acrysoftoriccalculator.com to determine the optimal incision location, the Toric IOL model and its axis of placement, important step includes marking of patient’s cornea for incision location and axis of placement. Axis marking for TORIC IOL is routinely done in 2 steps. Step-1 is reference marking (Figure a) and Step-2 is axis marking for Incision location and IOL Placement (Figure b).

In “OPAI TECHNIQUE” we used slit-lamp incorporated with degree of axis for slit beam i.e. 0-180 Degree. With the help of this degree on slit-lamp, slit beam is adjusted to desire axis and cornea is directly marked for incision location and axis of placement.

After instillation of Proparacaine eye drops wire speculum is applied. Patient in sitting upright position was asked to look directly on the light of the slit-lamp, so that visual axis remains straight. Slit beam was adjusted to desired axis of markings and beam was focused on the centre of the cornea Figure 2.

Sinski hook with dye on the tip was used, for single marking on the cornea near limbus for incision location. After rotating the slit beam to the desired axis of IOL placement, the process of marking is repeated with two marks on the cornea 180 degree apart as in Figure 3.

The slit beam is placed at the center of the cornea with the help of purkinje images so that there should not be any off axis marking on the cornea. Markings are rechecked by fine adjusting the beam on the desired axis again. This recheck confirms the exact location of marking as well as also guide us if the markings are slightly off axis. This technique is an excellent way to confirm the post
operative axis of placement of IOL in the bag with the help of slit beam. This post-operative examination on slit lamp gives us the exact axis of placement of IOL and to see the rotational stability of IOL in follow ups.

**RESULTS**

“OPAI TECHNIQUE” is simplified technique of marking of cornea for Toric IOLs, require no additional cost. No extra step is required in this technique. This technique eliminates the 2 stage marking for toric IOLs implantation as directly second stage of axis marking is done in sitting position.

**DISCUSSION**

Axis marking for TORIC IOL is routinely done in 2 STEPS. 1st step of Reference marking and 2nd step of axis marking for Incision location and IOL Placement. This new innovative technique gives excellent predictable and reproducible results as the reduplication of error due to any error in reference marking is eliminated. This technique also eliminates problem arising due to multiple marks on cornea as in conventional 2 stage marking.

**Preoperative and Postoperative Size and Movements of the Lens Capsular Bag: Ultrasound Biomicroscopy Analysis**

**Dr. Sonai Mukherjee, Dr. Sonu Goel**

To evaluate capsular bag size and accommodative movement before and after cataract surgery using ultrasound biomicroscopy (UBM).

**MATERIALS AND METHODS**

Eyes having cataract surgery and monofocal intraocular lens (IOL) implantation were studied using UBM. The following parameters were measured preoperatively and 1, 2, and 12 months postoperatively: anterior chamber depth (ACD) (also by AS-OCT), capsular bag thickness, capsular
bag diameter, ciliary ring diameter, sulcus-to-sulcus (STS) diameter, ciliary process-capsular bag distance, ciliary apex-capsular bag plane, and IOL tilting. The preoperative and postoperative capsular bag volumes were calculated at 12 months. The results were compared with the changes during accommodation.

**RESULTS**

The study comprised 24 eyes. With the exception of the ciliary apex-capsular bag plane, which appeared to be unmodified postoperatively, all measured parameters showed significant variation after IOL implantation. Only the ACD did not change significantly during accommodation.

After cataract surgery, the capsular bag stretched horizontally and with reduced vertical diameter as a result of adaptation to the implanted IOL. The capsular bag-IOL complex filled all available space, compressing the zonular fibers and almost abolishing the space between the ciliary apex and the capsular bag. There was anterior chamber deepening and a decrease in the ciliary ring diameter and STS diameter. In the absence of zonular fiber tension, the shape of the ciliary processes may be modified.

HIGH-FREQUENCY ultrasound biomicroscopy (UBM) is an invaluable tool in the pre- and postoperative assessment of patients undergoing implantation of phakic and aphakic IOLs, according to Philippe Sourdille MD. “Imaging technology such as high frequency ultrasound is extremely useful in the monitoring of anterior and posterior chamber changes after implantation of phakic and aphakic IOLs,” said Dr Sourdille.

A series of studies carried out by Marina Modesti MD at the University of Verona, Italy, showed the benefit of using high-frequency ultrasound biomicroscopy to dynamically measure anterior and posterior segment changes under physiological and surgical conditions. The research demonstrated that many cataractous lenses are situated behind the ciliary ring at the time of surgery and showed that most current IOLs are too large for the observed capsular bag and ciliary ring dimensions. This retrociliary position will prevent any forward movement of the IOL. 16 out of 29 eyes examined in her study had a backwards movement of the IOL after their cataract operation.

This carried importance implicated for the future design of both standard and accommodating IOLs.

While there is some forward movement with so-called accommodating IOLs, it is not of sufficient magnitude to create enough pseudo-accommodation.

Also the increase of intraocular movements at the ciliary ring and sulcus to sulcus levels, as well as at the level of the implanted capsular bag.

Intraocular lens diameters vary from 10.60 to 14.00mm and are chosen using biometric measurement of the axial length (AL) of the eye without
individual consideration of the actual capsular bag diameter. Complications of inappropriate IOL sizing include an overstretched capsular bag and IOL decenteration and tilt. Cataract surgery with single-piece monofocal IOL implantation in the capsular bag allows partial anatomic and functional restoration of the bag and visual rehabilitation for distance. However, the lack of elasticity of the IOL optic prevents restoration of the true accommodative capacity in response to ciliary muscle contraction. Capsular bag elasticity and free IOL movement in the capsular bag are fundamental to maintaining pseudophakic accommodation.

Some monofocal or accommodating IOLs were designed to follow the modifications of the capsular bag during the accommodative process by shifting the optics anteriorly in the active phase.

The aim of this study was to evaluate the modifications in the anatomic structures of the anterior segment and capsular bag during accommodative physiologic stimuli in cataractous eyes before and after cataract surgery with IOL implantation. The changes were measured using high-frequency ultrasound biomicroscopy (UBM).

UBM is a Bscan ultrasonic immersion procedure with a linear scanning mode providing quantitative and qualitative information about structures of the anterior segment. The normal B scan probe works at a resolution of 10 to 12 Mhz while the UBM probe works at a frequency of 35-50 Mhz or higher. The basic parts of a UBM are the same as that of a standard ultrasound and consist of a handpiece with transducer, a computer console which has the required hardware and software specific for the purpose, a monitor, printer and foot switch. While the Paradigm UBM uses a PMMA cup with Methyl Cellulose as coupling agent, most of the other machines have a silicon cup with water as the coupling media. The transducers in the newer
machines are threaded on and can easily be interchanged for one of a different frequency (Figure 1). In the Paradigm machine the transducer is mounted on a gantry while for the Sonomed, OTI Technologies and Appasamy Gantec the transducer is relatively light in weight and can be hand held. The UBM has a low penetration because of high frequency and should be kept at least 11mm from the cornea. The sweep at maximum setting includes 256 A scans coupled to give a B image and consists of an area of pixels.

### Table 1

<table>
<thead>
<tr>
<th>Name</th>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle opening distance</td>
<td>AOD</td>
<td>Distance between the trabecular meshwork and the iris at 500 microns</td>
</tr>
<tr>
<td>Trabecular-iris angle</td>
<td>TIA 01</td>
<td>Angle of the angle recess</td>
</tr>
<tr>
<td>Trabecular-ciliary process distance</td>
<td>TCPD</td>
<td>Distance between the trabecular meshwork and the ciliary process at 500 micron anterior to the scleral spur</td>
</tr>
<tr>
<td>Iris thickness</td>
<td>ID1</td>
<td>Iris thickness at 500 micron anterior to the scleral spur</td>
</tr>
<tr>
<td>Iris thickness</td>
<td>ID2</td>
<td>Iris thickness at 2 mm from the iris root</td>
</tr>
<tr>
<td>Iris thickness</td>
<td>ID3</td>
<td>Maximum iris thickness near the pupillary edge</td>
</tr>
<tr>
<td>Iris-ciliary process</td>
<td>ICPD</td>
<td>Distance between the iris and the ciliary process</td>
</tr>
<tr>
<td>Iris-zonule distance</td>
<td>IZD</td>
<td>Distance between the iris and the zonule along the line of TCPD</td>
</tr>
<tr>
<td>Iris-lens contact distance</td>
<td>ILCD</td>
<td>Contact distance between the iris and the lens</td>
</tr>
<tr>
<td>Iris-lnes angle</td>
<td>ILA 02</td>
<td>Angle between the iris and the lens near the pupillary edge</td>
</tr>
</tbody>
</table>

**MATERIALS AND METHODS**

This study comprised eyes with advanced cortical and nuclear cataract that had standardized cataract surgery. All patients planned for elective cataract surgery were evaluated. All patients had been explained about the procedure. Age group of 40-70 yrs (Figure 3).

Exclusion criteria included a preoperative history of ocular trauma, other ophthalmic disease (e.g., pseudoexfoliation syndrome, glaucoma, uveitis), and retinal disorders.

The patients were examined pre-operatively and 1, 2, and 12 months postoperatively. The examinations included clinical evaluation and UBM.
Surgical Technique
All patients underwent temporal clear corneal phacoemulsification with monofocal foldable IOL of Optic size of 13mm and an optic diameter of 6.0 mm. The same surgeon (S.G.) performed all surgeries. The technique included superior self-sealing incisions, phacoemulsification, and IOL implantation in the capsular bag.

Visual Acuity
Corrected distance visual acuity (CDVA) was evaluated using Snellen chart. Corrected near visual acuity (CNVA) was evaluated using Jaeger charts at 30 cm under subjective near-point accommodation with the minimum added positive sphere.

Anatomic Measurements
The UBM was performed using a Optikon 2000 with a 35 MHz probe. This system has a tissue penetration depth to 8.0 mm. The entire anterior segment is represented in a single image with an axial resolution of 50 mm and lateral resolution of 70 mm. The scan is angular (8 scans/second); the image area is 15.0 mm X 15.0 mm in normal-resolution mode and 5.0 mm X 5.0 mm in high-resolution mode. The UBM examination was performed with the patient supine.

After topical anesthesia was administered, the eye was examined under constant photopic illumination conditions (190 lux) using a cup filled with a saline isotonic solution. To evaluate the anterior segment structures in relaxed accommodation, the patient was asked to focus with the eye not being examined on the ceiling over patient’s head.

The cataract or the IOL in the capsular bag was examined on the axial horizontal section (transverse diameter passing through the corneal apex from 3 to 9 o’clock). Pre-operatively, the cataract allowed easy discrimination of the capsular bag equator.

- After IOL implantation, the capsular bag equator was identified through the high reflectivity of the terminal portion of the haptics, the high reflectivity resulting from the collapsed anterior and posterior lens capsules, or both.

Quantitative: Anterior chamber depth (ACD) with UBM and OCT with anterior segment module
- Capsular bag thickness
- Capsular bag dimension (vertical and horizontal )
- Sulcus-to-sulcus (STS) diameter
- Ciliary process-capsular bag distance
- Qualitative: IOL positioning.
The anterior chamber depth (ACD) was measured in the center of the pupil, along the optical axis, from the corneal endothelium to the anterior surface of the crystalline lens pre-operatively and from the corneal endothelium to the anterior surface of the IOL postoperatively.

The central capsular bag thickness was measured from the anterior to the posterior surface of the crystalline lens pre-operatively and from the anterior surface of the IOL to the posterior surface of the lens capsule postoperatively.

The maximum capsular bag diameter (equatorial poles from 3 to 9 o’clock in right eyes and from 9 to 3 o’clock in left eyes) was selected from the videos acquired pre-operatively and postoperatively.

The preoperative and postoperative ciliary ring diameter corresponded to the maximum distance between the ciliary apex processes from 3 to 9 o’clock in right eyes and from 9 to 3 o’clock in left eyes on the horizontal meridian.

The STS diameter corresponded to the maximum distance between the ciliary sulcus recesses on the horizontal meridian from 3 to 9 o’clock in right eyes and from 9 to 3 o’clock in left eyes.

The ciliary process–capsular bag distance corresponded to the zonular space between the capsular bag equator and the ciliary process apex. When the

**Table 2**

<table>
<thead>
<tr>
<th>Prototype Patient Data</th>
<th>Preoperative</th>
<th>Post-op 1 month</th>
<th>Post-op 2 months</th>
<th>Post-op 12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior Chamber Depth</td>
<td>3.08 mm</td>
<td>3.09mm</td>
<td>3.10mm</td>
<td>3.09</td>
</tr>
<tr>
<td>Ciliary Apex- Capsular Bag Distance</td>
<td>Sup: 1.13 mm</td>
<td>0.91 mm</td>
<td>0.9 mm</td>
<td>0.91 mm</td>
</tr>
<tr>
<td></td>
<td>Inf: 2.60 mm</td>
<td>1.64 mm</td>
<td>1.64 mm</td>
<td>1.63 mm</td>
</tr>
<tr>
<td>Capsular Diameter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Horizontal</td>
<td>7.91 mm</td>
<td>9.54 mm</td>
<td>9.71 mm</td>
<td>9.75 mm</td>
</tr>
<tr>
<td>-Vertical</td>
<td>9.10 mm</td>
<td>0.32 mm</td>
<td>0.33 mm</td>
<td>0.35 mm</td>
</tr>
<tr>
<td>Sulcus to Sulcus Diameter</td>
<td>11.42 mm</td>
<td>10.38 mm</td>
<td>10.35 mm</td>
<td>10.35 mm</td>
</tr>
</tbody>
</table>
The zonular space is compressed by the IOL, the capsular bag diameter and the ciliary ring diameter coincide.

The ciliary apex–capsular bag plane was measured as the position of the capsular bag containing the crystalline lens or the IOL with respect to the plane passing through the ciliary process apexes (Figure 4).

**RESULTS**

The study enrolled 24 eyes of 20 patients (8 men, 12 women). The mean age at

**Graphical analysis**
surgery was 58 years (range 40 to 70 years) and the mean AL 22.96 mm (range 20.62 to 25.63 mm). The mean IOL power was +21.46 dioptres. No significant (affecting visual acuity) posterior capsule opacification occurred, and no eye required a neodymium:YAG capsulotomy.

**DISCUSSION**

The aim of this study was to measure the anatomic variations in the anterior segment induced by IOL implantation and by physiologic accommodation stimuli before and after cataract surgery, mainly using ultrasound scans.

Although it has been suggested that the results of laser interferometry are more reproducible than those obtained by UBM or OCT when assessing capsule dynamics after cataract surgery.

Intraocular lens implantation is generally considered to cause modifications in the shape of the capsular bag, including postoperative flattening, increased diameter, and decreased diameter resulting from centripetal movement of the ciliary processes during accommodation.

We noticed that in most cases, active accommodation was associated with anterior bowing of the IOL loops and with a decrease in capsular bag diameter.

We also found that the enlargement of the capsular equatorial diameter (capsular bag diameter) was associated with a decreased distance from the ciliary apexes (ciliary process–capsular bag distance), seemingly as a result of compression of the zonules.

As others have suggested, the enlargement may be caused by the use of
oversized, not custom, IOLs. Capsular bag shrinkage combined with IOL design and material may be responsible for the changes in the postoperative IOL position. Findings of a reduction in ciliary ring diameter and STS diameter during active accommodation and a postoperative posterior ciliary apex–capsular bag plane, together with a good subjective accommodative capacity. Some authors stated that a deep ACD caused slightly more IOL movement in the plate–haptic group than a shallower ACD and suggested posterior positioning of the IOL to obtain anterior movement of the IOL.

The finding was in agreement with the theory that IOL movement is not induced by radial contraction of the ciliary muscle on the haptics but rather by vitreous pressure from behind after muscle contraction.

In conclusion, we believe that our results may prove helpful in improving IOL design to obtain optimum predictable performance in the capsular bag.

Postoperatively, the capsular bag is frequently enlarged and misaligned in the ciliary plane. which is the key to potential true accommodation.

Better adaptation of the IOL to the changes in capsular bag diameter seems to be necessary to improve the precision and stability of the refraction and would be the first step to designing a truly accommodative IOL.

REFERENCES


8. Marina Modesti, MD, Giacomo Pasqualitto, PhD, Rossella Appolloni, MD, Irene Pecorella, MD, Philippe Sourdille, MD PU JCRS 2011 VOL 37.
Pupil Dilatation with Topical Mydriatic Eye Drops and Preservative Free Intracameral Lidocaine During Topical Phacoemulsification Surgery: A Prospective Randomized Study

Dr. Suresh Pandey, Dr. Vidushi Sharma

Cataract surgery requires adequate mydriasis, which is usually achieved by topical and/or intracameral administration of anticholinergic and/or sympathomimetic mydriatic agents, commonly tropicamide, phenylephrine and cyclopentolate. These regimens, however, have some disadvantages such as slow onset of dilation, which increases the waiting time before operation, allergic reaction, adverse ocular and systemic effects, which are specially important in high-risk groups such as hypertensive patients and children and their tendencies to wear off during surgery.

Injection of 0.2 ml of 1% preservative-free lidocaine (lignocaine) in anterior chamber can have a persistent, stable and satisfactory pupil dilation for a safe phacoemulsification and IOL implantation in different patients including currently shown patient allergic to topical dilators eye drops, as well as diabetic and non-diabetic and eyes with pseudoexfoliation. Lidocaine is an antiarrhythmic drug as well as an effective local anesthetic.

Intracameral injection of preservative-free lidocaine is used widely for local anesthesia and discomfort relief in cataract. Intracameral lidocaine has some advantages over topical mydriatics. It doesn't need time-consuming preoperative program for pupillary dilation, doesn't have systemic side-effects of topical mydriatics and provides satisfactory pupillary dilation as well as simultaneous anesthetic effect in phacoemulsification cataract surgery. Intracameral injection of preservative-free lidocaine was attempted as an alternative to reduce the potential disadvantages of common mydriatics during surgery.

Lidocaine causes no additional inflammation and endothelial cell loss and its safety has been confirmed in previous studies. The purpose of this study was to evaluate pupillary dilation by an intracameral injection of nonpreserved lidocaine 1% (Oculain) during phacoemulsification cataract surgery and compared the results with those using conventional topical mydriatics.

MATERIALS AND METHODS

The prospective study included 40 cataract patients who were given topical mydriatics (20 eyes) or 1% intracameral lidocaine (20 eyes) to dilate the pupil for phacoemulsification and intraocular lens implantation. Exclusion
criteria were previous ocular surgery or laser procedures, iris abnormalities, pseudoexfoliation, systemic diagnosis affecting pupil dilation such as diabetes mellitus or Homer’s syndrome, and use of topical ocular medications (except artificial tears).

The topical group (Group A) received 3 drops of tropicamide 1% and phenylephrine 10% given 5 minutes apart starting 60 minutes before surgery. The intracameral group (Group B) received preservative-free lidocaine 1% (0.2 to 0.3 mL Oculain) injected just before the procedure began.

All patients signed an informed consent. In both groups, horizontal pupil diameter was measured with a caliper using the operating microscope in the operating room. Measurements were taken 10 minutes before surgery in the topical group and just before surgery in the intracameral group. The light intensity of the microscope was the same in both groups. The measurements were repeated with the same caliper just before surgery began in the topical group and 90 seconds after intracameral injection in the intracameral group. All patients were given 3 drops of proparacaine 1% at 5-minute intervals before surgery. The procedures were performed by the same surgeon (SKP). Total surgical time, need for a mydriatic agent during the procedure, and subjective surgical performance were recorded.

**RESULTS**

The mean age, sex, cataract density, baseline horizontal pupil diameter, and mean duration of the surgery were the same between the topical group (Group A) and intracameral group (Group B). The mean pupil dilation was 6.12 mm (SD 0.08 ) in the intracameral group and 6.10 (SD 0.09) mm in the topical group; the difference between groups was statistically insignificant. There was no significant difference between groups in the overall subjective surgical performance.

**DISCUSSION**

This study shows that injection of 0.2 to 0.3 mL of preservative-free lidocaine 1% in the anterior chamber provides persistent, stable, satisfactory pupil dilation for safe phacoemulsification and IOL implantation. Although the mean pupil diameter was significantly greater in the intracameral group, the overall surgical performance and duration of surgery were not significantly different between the 2 groups.

The injection of intracameral lidocaine has advantages over topical mydriatics. It shortens the time it takes for the pupil to dilate pre-operatively, does not have systemic topical mydriatic side effects, and provides better pupil dilation as well as a simultaneous anesthetic effect for phacoemulsification.
Lidocaine is an antiarrhythmic drug as well as an effective local anesthetic. Intracameral injection of preservative-free lidocaine is used widely for local anesthesia and discomfort relief in cataract surgery. Lidocaine causes no additional inflammation and endothelial cell loss and its safety has been confirmed in previous studies.

Intracameral lidocaine has some advantages over topical mydriatics. It doesn't need time-consuming preoperative program for pupillary dilation, doesn't have systemic side-effects of topical mydriatics and provides satisfactory pupillary dilation as well as simultaneous anesthetic effect in phacoemulsification cataract surgery.

In conclusion during phacoemulsification, intracameral preservative-free lidocaine 1% provided rapid, effective mydriasis comparable that of topical mydriatics. Intracameral lidocaine also provided anesthesia while performing topical phaco surgery.

REFERENCES

Comparing Higher order Aberrations and Optical Quality between Aspherical Intraocular Lenses and Multifocal Intraocular Lenses

Dr. Sudeep Das, Dr. Ridhima Bhagali, Dr. Somshekar Nagappa

Recent advances in cataract surgery, intraocular lenses and introduction of wavefront analysis has led to new horizons of vision beyond emmetropia in terms of visual quality. Visual abnormalities like optical scatter and higher order aberrations hamper quality of vision and thereby reducing patients’ satisfaction.

To assess optical quality outcomes in patients undergoing cataract with monofocal and multifocal intraocular lens implant. To determine whether there is any deterioration of optical quality in MFIOLs compared to Aspherical IOLs.

Study design: Non-randomized, Prospective, Cohort Study.
MATERIALS AND METHODS

Patients were recruited and consecutively enrolled in the study in a tertiary eye care centre, Narayana Nethralaya, Bangalore, India. All patients provided written informed consent after receiving a full explanation of the nature of the study, including risks and benefits.

Inclusion criteria

Patients who had undergone uneventful cataract surgery for immature senile cataract with implantation of aspheric intraocular lens with visual acuity of uncorrected 6/6 on Snellen’s visual acuity chart at 6 weeks follow-up were included in the study. For multifocal lens patients, in addition to uncorrected distance visual acuity of 6/6, a near vision of 6/6 was a required to be included into study.

Exclusion criteria

Patients having uncorrected visual acuity of less than 6/6 on Snellen’s visual acuity chart. Patients with multifocal IOL, near visual acuity of less than N6 were also not included for study. Patients unwilling to participate in study

Post-operative evaluation at 6 weeks after cataract surgery included uncorrected distance and near visual acuity (UCDVA and UCNVA), best corrected distance and near visual acuity (BCDVA and BCNVA). Slit lamp biomicroscopy and assessment of intraocular pressure using non-contact tonometry was done.

In addition, Objective evaluation of the optical vision quality was performed using the Optical Quality Analysis System (OQAS) II double-pass system (Visiometrics). It allows measuring of the joint effect of higher order optical aberrations and loss of transparency of ocular tissues on the quality of the retinal image. The data provided by this instrument are established by a study of the retinal image obtained after focusing an infra-red light. Ocular scattering (reduction of the ocular transparency) can be analysed and is used to predict its effects on the contrast sensitivity and the maximum theoretical visual acuity. The parameters assessed using OQAS were Modulation transfer function (MTF), optical scatter index (OSI), Strehls ratio (SR) and the Simulated Visual Experience.

Modulation transfer function (MTF)

The MTF corresponds to the ratio of the image contrast to the object contrast, with MTF value being the highest when the image and object contrasts are the same. Under theoretically optimum conditions, the maximum spatial frequency detectable by the human eye is close to 60 cpd, and the higher the MTF cut off value, the better the contrast sensitivity.
Optical scatter index (OSI)
Intraocular scattering may severely degrade the retinal image quality (14). OSI is an objective parameter of intraocular scattered light. The higher the OSI value, the higher the level of intraocular scattering. OSI for normal eyes would range around 1.

Strehls Ratio (SR)
It is defined as the ratio of the observed peak intensity at the detection plane from a point source as compared to the theoretical maximum peak intensity of a perfect imaging system working at the diffraction limit. The higher the Strehls Ratio, higher is the visual quality.

Simulated Visual Experience
The OQAS pictorially represents the patient’s visual experience at contrast levels of 100%, 20% and 9% by extrapolating the decimal visual acuity and visual acuity chart.

Higher order aberrations (HOA) were measured using Nidek OPDIII scan. Nidek OPDIII scan works on principle of differential skiascopy and gives measurement for internal, corneal and total HOAs.

RESULTS

<table>
<thead>
<tr>
<th>Table 1: Objective Scatter Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model of IOL</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Acrysof IQ</td>
</tr>
<tr>
<td>IQ ReSTOR +3</td>
</tr>
<tr>
<td>Tecnis 1</td>
</tr>
<tr>
<td>Tecnis Multifocal</td>
</tr>
</tbody>
</table>

The deterioration in OSI of ReStor MFIOL versus Acrysof IQ was statistically significant (p=0.00), while it was not significant for Tecnis 1 versus Tecnis MFIOL.

<table>
<thead>
<tr>
<th>Table 2: Modulation Transfer Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model of IOL</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Acrysof IQ</td>
</tr>
<tr>
<td>IQ ReSTOR +3</td>
</tr>
<tr>
<td>Tecnis 1</td>
</tr>
<tr>
<td>Tecnis Multifocal</td>
</tr>
</tbody>
</table>

The difference was not statistically significant.
Table 3: Strehl Ratio

<table>
<thead>
<tr>
<th>Model of IOL</th>
<th>SR (Average ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrysof IQ</td>
<td>0.217 ± 0.16</td>
</tr>
<tr>
<td>IQ ReSTOR +3</td>
<td>0.166 ± 0.08</td>
</tr>
<tr>
<td>Tecnis 1</td>
<td>0.172 ± 0.08</td>
</tr>
<tr>
<td>Tecnis Multifocal</td>
<td>0.181 ± 0.07</td>
</tr>
</tbody>
</table>

The difference was not statistically significant.

Table 4: Simulated Visual Experience:

<table>
<thead>
<tr>
<th>Model of IOL</th>
<th>Visual acuity 100% contrast</th>
<th>Visual acuity 20% contrast</th>
<th>Visual acuity 9% contrast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrysof IQ</td>
<td>1.07±0.42</td>
<td>0.81±0.33</td>
<td>0.48±0.21</td>
</tr>
<tr>
<td>IQ ReSTOR +3</td>
<td>0.96±0.36</td>
<td>0.69±0.33</td>
<td>0.40±0.25</td>
</tr>
<tr>
<td>Tecnis 1</td>
<td>1.00±0.44</td>
<td>0.72±0.34</td>
<td>0.44±0.23</td>
</tr>
<tr>
<td>Tecnis Multifocal</td>
<td>0.97±0.36</td>
<td>0.73±0.32</td>
<td>0.46±0.20</td>
</tr>
</tbody>
</table>

The difference was not statistically significant.

Table 5: Internal Higher Order Aberrations:

<table>
<thead>
<tr>
<th>Model of IOL</th>
<th>HOA (Average ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrysof IQ</td>
<td>0.411 ± 0.36</td>
</tr>
<tr>
<td>IQ ReSTOR +3</td>
<td>0.469 ± 0.97</td>
</tr>
<tr>
<td>Tecnis 1</td>
<td>0.319 ± 0.20</td>
</tr>
<tr>
<td>Tecnis Multifocal</td>
<td>0.326 ± 0.26</td>
</tr>
</tbody>
</table>

The difference was not statistically significant.

In conclusion, aspheric IOLs have significantly lower scatter index and good visual quality matrix. Multifocal IOLs have HOAs, MTF and vision at varying contrasts comparable with aspheric counterpart. Considering the benefit of near vision, the increased scatter (contributing to glare/haloes) is acceptable if the patient is prepared for it during pre-operative counselling. There is no significant increase in OSI in Tecnis MF over Tecnis. Though the Multifocal IOLs have a higher scatter index than their Aspheric counterparts, this doesn’t seem to have a significant adverse effect on the induced aberrations or the visual quality. The quality of vision in low contrast situations is also not significantly worse. Diffractive Multifocal IOLs should perform well in real-life situations, including night driving.
Preoperative Prediction of Intraoperative Posterior Capsule Rupture Based on Morphologic Features in Eyes with Posterior Polar Cataract

Dr. Viraj Vasavada, Dr. Vaishali Abhaykumar Vasavada, Dr. Samaresh Srivastava, Dr. Shetal Raj, Dr. Abhay Vasavada

Posterior polar cataracts pose a unique challenge to surgeons because they have a predisposition to posterior capsule dehiscence during cataract surgery.\(^1\) Posterior capsule rupture (PCR) rates as high as 26% and 36% have been reported in the past.\(^1-3\) However, with refinements in surgical techniques and technology, as well as better understanding of fluidics, the incidence of PCR has been reduced to 6-8%\(^3,4\) in more recent studies.

However, identifying morphologic characteristics of the cataract that could predict posterior capsule dehiscence preoperatively would be very useful to the surgeon, not only to plan the surgical strategy, but also to counsel the patients. Not much is known\(^5\) about the morphologic characteristics of the cataract that could predict the occurrence of PCR intraoperatively.

The aim of this study was to identify risk factors, including size of the posterior polar cataract, age of patient or family history that may help predicting preoperatively the likelihood of a PCR in a posterior polar cataract.

MATERIALS AND METHODS

This prospective, interventional case series included consecutive eyes of patients undergoing phacoemulsification for posterior polar cataracts at Iladevi Cataract and IOL Research Centre between January 2010 and February 2012. The study was approved by the Institutional Review Board. Informed consent was taken from every patient before enrollment into the study. A thorough preoperative counseling was done, explaining to the patient and their family the enhanced risk for posterior capsule rupture, nucleus drop and intervention by retinal surgeon.

A detailed history was elicited from the patient regarding presence of posterior polar cataract in the fellow eye, or history of posterior polar cataract in any family member. For those patients undergoing phacoemulsification in the second eye, their charts were reviewed for presence of posterior polar cataract and / or posterior capsule rupture in the fellow eye.

A complete ophthalmic examination was performed, including slit lamp biomicroscopy, intraocular pressure assessment (Goldmann applanation tonometry) and a detailed fundus evaluation. Diagnosis of a posterior polar cataract was made based on its characteristic clinical appearance.\(^6\) Presence of
a pre-existing dehiscence in the posterior capsule was noted. Axial length was measured using the IOL master (Zeiss) or the immersion ultrasound A-Scan (Ocuscan, Alcon). White-to-white corneal diameter and anterior chamber depth were calculated on the IOL master (Zeiss). Lens thickness was measured using the immersion ultrasound A-scan. Images of the cataract were captured preoperatively for each eye using digital slit lamp phorograpy (Haag Streit, BX 900). Images were captured by one of two experienced examiners at standardized magnifications of 10X and 16X. For every eye, an image was taken with diffuse illumination, such that the white-to-white diameter could be visualized alongwith the polar opacity. Next, a retroillumination image showing the white-to-white diameter as well as the opacity was captured. The associated types of cataracts (e.g. cortical, nuclear) were classified and graded according to the Emery and Little classification.

**Surgical Technique**

All surgeries were performed by a single surgeon (ARV), using a standardized surgical technique. An initial 1.0mm clear corneal paracentesis was created using a dual bevel knife (Alcon Labs, USA).

Thereafter, a dispersive ophthalmic viscosurgical device (OVD), Viscoat (Alcon) was injected, followed by injection of a cohesive OVD, Provisc (Alcon) underneath it as per the soft shell technique. A 2.2mm temporal, single-plane, clear corneal incision was made in all eyes. Thereafter, anterior capsulorhexis was fashioned. Following capsulorhexis, a central trench was sculpted. Care was taken to not mechanically rock the lens. Dispersive OVD, Viscoat was injected in the anterior chamber before withdrawing the phaco probe from the eye.

Thereafter, inside-out-delineation⁴ was performed using specially designed right and left angled cannulae. Nucleus was divided using the step-by-step chop in-situ and lateral separation technique⁸ in eyes with associated nuclear sclerosis, whereas in eyes with soft cataracts, four quadrant nucleotomy technique was used. The nucleus was removed keeping the epinucleus cushion intact. The epinucleus was then stripped off, starting in the peripheral half, leaving the central area attached. Bimanual irrigation/aspiration was performed for cortex removal. In cases where the posterior capsule was intact, a single-piece hydrophobic acrylic IOL was implanted in the capsular bag. In case of posterior capsule rupture, bimanual limbal anterior vitrectomy was performed to deal with prolapsing anterior vitreous wherever required. Preservative-free triamcinolone acetonide was used to identify vitreous strands in the anterior chamber. Depending on the capsular support, either a single-piece hydrophobic acrylic IOL was implanted in the bag, or a 3-piece hydrophobic acrylic IOL was implanted in the ciliary sulcus.
Observations

Based on the slit lamp photographs of the polar opacity, the following parameters were measured using the Image J software (version 1.44): horizontal diameter, vertical diameter, area of the polar. The Image J is an image processing and analysis software developed by the NIH (National Institute of Health) The image was first imported into the software. Taking the measured white-to-white diameter as the reference, the scale for measurement was calibrated in the software. Thereafter, using measuring tools, the horizontal and vertical diameters of the posterior polar opacity were measured in millimeters (mm). For measuring the area of the opacity, a manual selection tool was used to demarcate the boundaries of the polar opacity. Based on this, the software calculated the area of the polar opacity in mm².

All eyes were operated on an OPMI Visu 210 operating microscope (Zeiss) with a slit lamp attachment was used. A fixed magnification of 0.7 and illumination of 1.0 was used in all cases. Following insertion of speculum the following variables were recorded on a separate data entry form for each patient:

- Number of concentric rings
- Presence or absence of white dots in the centre of the opacity
- Presence or absence of thinning in the centre of the opacity
- Presence or absence of vacuoles in the periphery of the polar opacity
- Presence or absence of fibrosis in the periphery of the polar opacity

Occurrence of PCR or any other intraoperative complications were noted.

Outcome Measures

The following parameters were analyzed between eyes that had an intraoperative PCR versus eyes that did not have:

- Age, Axial length, Anterior chamber depth, Lens thickness, Number of concentric rings, Horizontal and vertical diameters of the opacity, Area of the opacity, presence of central thinning, vacuoles or fibrosis around the opacity.

Statistical Analysis

Statistical analysis was done using SPSS software, version 12 (SPSS Inc). The Mann-Whitney U Test was used for analysis. A P value of <0.005 was considered statistically significant.

RESULTS

93 eyes of 84 patients were included in the study. 75 patients underwent unilateral cataract surgery, and 9 underwent bilateral surgery. The mean age of patients was 51.18 ± 9.78 years (range 26 to 72 years). There were 63 males
and 30 females. 1 patient had a family history of posterior polar cataracts with posterior capsule defect in two brothers, and 1 patient had a history of posterior capsule rupture during cataract surgery in the fellow eye.

Phacoemulsification was performed under topical anesthesia in all eyes. No eye had a pre-existing posterior capsule dehiscence. 8 out of 93 eyes (8.6%) eyes had an intraoperative PCR. One patient undergoing bilateral surgery had a PCR in both eyes. In 5 out of 8 eyes, there was no vitreous disturbance and an IOL could be placed in the capsular bag. In other 3 eyes, anterior vitrectomy was performed followed by placement of a 3 piece hydrophobic acrylic IOL in the ciliary sulcus. 1 eye had a nuclear fragment drop into the vitreous cavity, which was managed by pars plana vitrectomy.

Preoperatively, the age, axial length, anterior chamber depth and lens thickness were comparable between eyes that had a PCR and eyes that did not (Table 2).

On comparing morphological features of the cataracts (Table 3), the mean horizontal diameter of the polar opacity was larger in eyes that had a PCR (3.68 ± 0.42mm), compared to eyes that did not have a PCR (2.85 ± 0.94mm), although the difference was not statistically significant (P=0.09). Similarly, the overall area of the polar opacity was found to be larger, although not statistically significant, in eyes that had a PCR.

There was no difference in the number of concentric rings, thinning, vacuoles or fibrosis between the groups (Table 3). 34 of the 93 eyes (36.55%) had associated nuclear sclerosis, of which 12 eyes had nuclear sclerosis of grade 3 or 4. Of the eyes that had intraoperative PCR, 4 (50%) had associated nuclear sclerosis. However, 3 of these 4 eyes had nuclear sclerosis of grade 4, and 1 had nuclear sclerosis of grade 3. In contrast, in the group that did not develop PCR, only 1 eye had a grade 4 nuclear sclerosis. Grade 4 nuclear sclerosis was thus found to be more frequent in eyes that developed a PCR.

**DISCUSSION**

Since posterior polar cataracts are prone to dehiscences or rupture in the posterior capsule, there have been several surgical techniques to reduce the incidence of PCR during posterior polar cataract surgery (ref). As a result of improvements in surgical techniques and technology, the rates of PCR have come down from 36% and 26%1,2 in the past, to 6% to 8% in more recent studies.3,4 Our current study shows an 8.6% incidence of PCR, which is similar to the one reported by us in 2004. Thus, it is not possible to eliminate PCR in a case of posterior polar cataract. Therefore, if there are any characteristics of the patient or the cataract, which can predict a greater likelihood of posterior capsule dehiscence prior to performing surgery, this would be very useful to the surgeons.
Table 1: Ultrasound and Aspiration Parameters used during different stages of surgery

<table>
<thead>
<tr>
<th>U/S Energy (Torsional), Burst Mode</th>
<th>Vacuum (mmHg)</th>
<th>Aspiration Flow Rate (cc/min)</th>
<th>Bottle Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sculpting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60% preset amplitude, 300ms on time, 50 ms off time</td>
<td>120</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Chopping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60% preset amplitude, 300ms on time, 50 ms off time</td>
<td>40 -50 (for soft cataracts),</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>200-400 (for dense cataracts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear Fragment Removal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60% preset amplitude, 300ms on time, 50 ms off time</td>
<td>200 to 300, depending on grade of nuclear sclerosis</td>
<td>20</td>
<td>90</td>
</tr>
</tbody>
</table>

Table 2: Biometric parameters of eyes undergoing phacoemulsification for Posterior Polar Cataracts

<table>
<thead>
<tr>
<th>Eyes having PCR (n=8)</th>
<th>Eyes not having PCR (n=85)</th>
<th>P Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>52.13 ± 13.7</td>
<td>51.09 ± 9.4</td>
</tr>
<tr>
<td>Axial Length, mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>23.42 ± 0.79</td>
<td>23.61 ± 0.98</td>
</tr>
<tr>
<td>Anterior Chamber Depth (ACD), mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>3.48 ± 0.35</td>
<td>3.48 ± 0.38</td>
</tr>
<tr>
<td>White to White Diameter (WTW), mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>11.83 ± 0.68</td>
<td>12.3 ± 0.7</td>
</tr>
<tr>
<td>Lens Thickness, mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>4.0 ± 0.44</td>
<td>4.16 ± 0.46</td>
</tr>
</tbody>
</table>

* Mann Whitney U Test, P value <0.05 considered statistically significant
Table 3: Morphologic characters of posterior polar cataracts

<table>
<thead>
<tr>
<th></th>
<th>Eyes having PCR (n=8)</th>
<th>Eyes not having PCR (n=85)</th>
<th>P Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>**Horizontal Diameter (mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>3.68 ± 0.42</td>
<td>2.84 ± 0.94</td>
<td>0.09</td>
</tr>
<tr>
<td>**Vertical Diameter (mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>3.8 ± 0.58</td>
<td>3.0 ± 1.25</td>
<td>0.21</td>
</tr>
<tr>
<td>**Area of Opacity (mm²)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>10.49 ± 3.86</td>
<td>7.0 ± 4.87</td>
<td>0.13</td>
</tr>
<tr>
<td><strong>Number of Concentric Rings</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>3.33 ± 1.0</td>
<td>2.67 ± 1.3</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Thinning of central posterior capsule</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present (n, %)</td>
<td>4 (50)</td>
<td>40 (48.19)</td>
<td>0.13</td>
</tr>
<tr>
<td><strong>Surrounding vacuoles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present (n, %)</td>
<td>5 (62.5)</td>
<td>50 (60.24)</td>
<td>0.12</td>
</tr>
<tr>
<td><strong>Fibrosis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present (n)</td>
<td>3 (37.5)</td>
<td>41 (34.85)</td>
<td>0.18</td>
</tr>
</tbody>
</table>

The posterior polar cataract has a characteristic morphology with a concentric onion-ring like appearance. The two types of posterior polar cataracts described in literature are: the stationary or the progressive type. The stationary type has a central disk-shaped opacity, having a bull's-eye appearance. It often has a cone-shaped projection in the subcapsular region or central posterior cortex. In the progressive type of posterior polar cataract, changes take place in the form of radiating rider opacities in the cortex, or surrounding vacuoles and / or fibrosis around the central polar opacity. In this study, we tried to see if any of these morphologic features were found more frequently in eyes that developed a PCR.

Recently, Kumar and colleagues reported that horizontal diameter of the polar opacity greater than 4mm is a risk factor for rupture in posterior polar cataracts. These authors reported a PCR rate of 15.5%. We found that eyes that developed PCR did have a slightly larger horizontal diameter, and greater area of the polar opacity, as compared to eyes that did not have a PCR, however, the difference did not attain statistical significance. We used the Image J software, which is designed to calculate area and pixel value statistics of user-defined selections. Using the measured white-to-white diameter as a reference on the photograph, the horizontal and vertical diameters, as well as the area of the polar opacity were calculated. This allowed automated, precise measurements, which were independent of magnification bias. This software has been validated in previous studies. However, to the best of our knowledge,
this is the first time this software is being used to measure dimensions of a cataractous opacity.

Very few studies\textsuperscript{3} have reported the nuclear density associated with their posterior polar cataracts. In the current study, 50\% eyes that developed a PCR had associated dense nuclear sclerosis of grade 3 or higher. The higher incidence of PCR, in presence of a dense nuclear cataract, could be attributable to the greater intraoperative manipulation during division and removal of the nuclear fragments. There are several techniques described for dealing with dense nuclear cataracts associated with posterior polar cataracts. Hayashi and colleagues\textsuperscript{3} suggest an alternative surgical technique of intracapsular cataract extraction with scleral fixation of IOL for posterior polar cataracts with nuclear sclerosis having a size larger than 4mm. However, Das and colleagues\textsuperscript{9} found a greater rate of PCR when performing ECCE as compared to phacoemulsification. Haripriya and colleagues\textsuperscript{10} advocate bimanual phacoemulsification in eyes with associated dense nuclear sclerosis and posterior polar cataracts, with the idea of separating irrigation and aspiration, as well as reducing the inflow into the eye. Chee and coauthors\textsuperscript{11} describe a technique for partially chopping for dense cataracts to reduce the stress on the weak posterior capsule. We believe that if a closed chamber technique is followed and low fluidic parameters are used, phacoemulsification can be performed safely in these eyes with an acceptable complication rate.

Our results show a male preponderance amongst patients undergoing surgery for posterior polar cataracts. This is in concordance with several previous reports.\textsuperscript{2,3,9} Age, axial length, anterior chamber depth and lens thickness were not significantly different between eyes that had a PCR versus eyes that did not. 1 of the 9 patients who underwent bilateral surgery during the study period had PCR in both eyes. Posterior polar cataracts are known to have a genetic predisposition. However, it has not yet been known whether an associated weakness of the posterior capsule could also be transmitted genetically or not. In our series, a total of 9 eyes had a positive family history of posterior polar cataracts. However, only 1 of these 9 eyes had an intraoperative PCR. Moreover, based on this small sample size, it is not possible to comment on familial tendency of posterior capsule weakness.

In conclusion, coexistence of dense nuclear sclerosis and posterior polar cataract was a risk factor for intraoperative PCR. Also, we found that in eyes that had a PCR, the horizontal diameter and overall area of the polar opacity were larger, although the difference did not attain statistical significance.

\textbf{REFERENCES}


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**A Single Drop 0.5% Proparacain Hydrochloride for Uncomplicated Clear Corneal Phacoemulsification**

**Dr. Rajesh Joshi**

Phacoemulsification is the method of choice for most cataract surgeons for the removal of cataract. Developments of self-sealing clear corneal incision and topical anesthesia have made fast postoperative functional recovery possible. Topical anesthesia is the safe and effective alternative to peribulbar and retro bulbar anesthesia for phacoemulsification.1,2 Intracameral preservative free xylocaine has been supplemented to topical anesthesia to minimize the intraoperative discomfort. However, a study has shown intracameral use of xylocaine has no clinically useful role during phacoemulsification.3 Moreover, few reports have cautioned cataract surgeons regarding potential corneal endothelial injury of anesthetic agents injected into the eye.4-6
The present study was done to evaluate the effectiveness of single drop application of 0.5% proparcain hydrochloride in phacoemulsification and compare it to intracameral 0.5% preservative free as a supplement to topical proparcain.

**MATERIALS AND METHODS**

Approval of the study was obtained from the ethical committee of the hospital. Written informed consent was obtained from each patient. This prospective, randomized and comparative study comprised 295 patients scheduled for phacoemulsification. Patient’s having operable cataracts of various nuclear grades were included in the study. The exclusion criteria were allergy to the topical anesthetics, deafness, nystagmus, barrier to the communication, extreme anxiety, neurological disorders, monocular patients, complicated and subluxated cataracts, non-dilating pupil and patients unable to understand visual analog scale.

Preoperatively, all patients had routine ophthalmic evaluation. Patients were randomized to two groups based on anesthetic agents they were to receive. Group 1 patients received a single drop of proparcain hydrochloride 2 min. before the start of the surgery placed in the lower fornix. Group 2 patients received a single drop of proparcain 2 min. before the surgery and supplement of intracameral 0.5% preservative free xylocaine. Preoperatively, the pupils were dilated with phenylephrine 5% tropicamide 0.8% eyedrops. No non-steroidal anti-inflammatory drugs were used preoperatively. No patients received preoperative or intra-operative sedation.

**Surgical technique**

All patients were operated by a single surgeon. No superior rectus suture was taken. Universal eye speculum was used in all cases. Patients were instructed to fixate on the microscope light during surgery. A side port incision was created on the appropriate side to stabilize the globe. 3.2 mm clear corneal temporal incision was taken through which viscoelastic was injected. A 5.5mm wide capsulorhexis was created using utrata forcep. Complete cortical cleaving hydro-dissection was performed by injecting a balanced salt solution between the lens capsule and the cortex with 27- gauge canula. Nucleus was divided using direct chop technique. Parameters were vacuum 350cc, flow rate 33cc and power 40-70 depending on the grade of the nucleus in a pulse mode (Swisstech, oertli phacoemulsifier system ,Switzerland ). Cortical clean up was done using I/A probe. A single piece hydrophobic or hydrophilic intraocular lens depending on the patient’s choice was implanted in the bag. The viscoelastic material was removed from the capsular bag and from the anterior chamber. Stromal hydration of the side port and main incision was done. No sutures were required in any case.
Time of the surgery was recorded by the accompanying surgeon from making the side port incision to the completion of the stromal hydration.

No patients received intracameral miotics during the surgery and subconjunctival injection at the completion of the surgery.

After the completion of the surgery patient was taken to the recovery room. A standard 10-point visual analog scale was used to assess intra-operative and post-operative pain. Post-operative pain was assessed 30 min. after the completion of the surgery. A trained para ophthalmic technician performed the job. Surgeon was not present during the assessment of pain score. Patient was also asked whether they would be going for similar type of anesthesia for other eye cataract surgery.

The surgeon’s subjective impression on corneal haziness (grade 0=clear, 1=mild hazy, 2=moderate, 3=severe), discomfort during the surgery (grade 0-nil, 1=mild, 2=moderate, 3=severe), complications and supplemental anesthesia was assessed.

Anesthetist also noted vital parameters like blood pressure, pulse rate and oxygen saturation during the surgery and any supplemental intravenous sedation required.

Comparison of parameters was done by Chi-square test. A P value less than 0.05 was considered statistically significant.

**RESULTS**

The study included 295 eyes of 295 patients. One hundred and forty six patients were in Group 1 (a single drop proparcain 0.5%) and 149 patients in Group 2 (intracameral supplement of 0.5% preservative free xylocaine). There were 146 females (Group 1 n=71, Group 2 n=75) and 149 males (Group 1 n=75, Group 2 n=74).

The mean age in Group 1 was 61.00 (+11.09) and in Group 2 58.71 (+10.09). Nine patients (3.05%) had grade 1, 34 patients (11.53%) had grade 2, 150 patients (50.85%) had grade 3 and 102 (34.58%) patients had grade 4 nuclei.

The average intra-operative pain score on visual analog scale (VAS) in Group 1 was 1.171 (+1.50, range 0-7) and in Group 2 it was 0.986 (+1.433, range 0-7). This difference in average was not statistically significant (p=0.24). Zero score i.e. no pain was seen in 41.8% patients in Group 1 and 46.3% patients in Group 2.

The mean postoperative pain score on VAS in Group 1 was 0.9246 (+1.0769) and in Group 2 0.7465(+ 0.9742) p=0.164.

The average surgical time in Group 1 was 6.470 min. (+1.106) and 6.913 min. (+4.450) in Group 2 (p=0.279). The average corneal haze during surgery in Group was 0.0616 (+0.315) and 0.1438(+0.4547) in Group 2 (p=0.56).
No patients required supplemental anesthesia. There were no surgical complications, which could compromise the visual outcome.

The average surgeon discomfort in Group 1 was 0.178 (+0.507) and in Group 2 was 0.102 (+0.402) p= 0.07.

One hundred and one (69.18%) patients had bilateral cataract in Group 1 and 89.11% patients considered same anesthetic technique. One hundred and twelve patients (90.18%) had bilateral cataracts in Group 2 and 90.18% patients considered same anesthetic technique for other eye cataract surgery.

No patients in either group had changes in vital parameters and required intravenous sedation.

DISCUSSION

Our study showed that a single drop preoperative instillation of proparcain hydrochloride provided satisfactory patient comfort to conduct safe phacoemulsification with implantation of intraocular lens in all grades of cataracts. There was no significant difference in intra-operative pain scores between two groups. Visual analog scale (VAS) score in Group 1 was 1.171 (+1.50), lower than the reports from other studies on phacoemulsification under topical anesthesia with repeated applications. Agarwal et. al. reported average VAS score as 1.44 (+1.04) with 4% xylocaine.9 Damigos et. al. reported VAS score 4.19 (+2.321) with 0.5% tetracain10 (ref-40) and Soliman et.al reported verbal pain score of 1.53 (+0.29) with 0.5% bupivacain.11 VAS score in proparcain group was equivalent to the supplemental intracammeral xylocard in a study conducted by Agarwal et.al.(1.16 + 1.17).9

Before we started our study, we investigated optimal protocol for instillation of proparcain hydrochloride. A single application was sufficient when applied 2-3 min. prior to the surgery when patient was taken to the operation theater table.

Lidocain 2% gel in single or multiple instillations has been reported to provide excellent anesthesia during phacoemulsification. [12, 13]. This is due to prolonged contact of the anesthetic agent to the corneal epithelium. However, corneal epithelial safety of the gel form of the lidocain has not been fully investigated. Our study proves a single drop instillation of proparcain is comparable to the single or multiple instillations of lidocain gel in terms of the patient and surgeons comfort.12,13

Postoperative VAS score and surgeons comfort while performing the surgery was no different in both the groups. The safety of the single drop application of proparcain was also proved by; no patient required supplemental anesthesia or intravenous sedation during the procedure. There were no intraoperative complications, no corneal haze, which could compromise the visual outcome.
The average surgical time in both the groups was almost equal (Gr 1 = 6.470 and Gr 2 = 6.913). Almost equal number of patients in both the groups preferred same type of anesthetic technique in both the groups (Gr 1 89.11% and Gr 2 90.18% patients).

However, surgeons’ expertise and experience are important factors in performing phacoemulsification in patients with minimal anesthesia. This study involves a single surgeon. Involving two or more surgeons with different expertise would add more weightage to the study.

In conclusion the study result demonstrates phacoemulsification can be performed under single drop instillation of proparcain hydrochloride 2min. preoperatively without compromising the visual outcome in all grades of cataracts. Pain experience and surgeon comfort was comparable in both the groups. The Ease of application, lack of toxicity and sufficient effect to complete the surgery make it an efficient alternative in uncomplicated clear corneal phacoemulsification. However, it is prudent to individualize the anesthetic technique according to the patient and surgeon need.

REFERENCES


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**Decoding Phacoemulsification using Intraoperative Realtime High Speed Imaging**

Dr. Samaresh Srivastava, Dr. Abhay Vasavada, Dr. Vaishali Abhaykumar Vasavada, Dr. Shetal Raj

As phacoemulsification techniques and technology evolve, there is continuous research into how the art and science of phacoemulsification can be enhanced even further.

Imaging with a high-speed camera has been used for slow-motion analysis in several fields, including automotive vehicle safety testing, military test ranges, fluid dynamics, and solid mechanics. It has been used extensively in the field of medicine to study the vocal cord and laryngeal dynamics in normal and abnormal conditions and movements of the sinonasal epithelial cells and in forensic science to study the interactions between bullets and the body.

However, although this technology has been used in ophthalmology to study eyelid blinking mechanisms, and in the laboratory to study details of phacoemulsification machines, there is no report of the use of this technology in the setting of a cataract surgery.

Applying this technology in the real-time operating scenario can help in visualizing many of the split-second phenomena that are beyond the limits of visualization using normal video recordings. It can help analyze surgical steps frame-by-frame and thus give a better understanding of the surgical procedure. We describe the use and applications of real-time high-speed imaging during phacoemulsification.

**MATERIALS AND METHODS**

**High-Speed Imaging**

A Pike F-032B video graphics array (VGA) camera (Allied Vision Technology) was used. It is equipped with a Kodak KAI-0340 charge-coupled device sensor. At full resolution, it runs 208 fps. The camera was mounted on an f=85 mm adapter to a beam splitter on the operating microscope (OpmiLumera 700,
Cark Zeiss Meditec AG) and then connected to a laptop with a 1 GHz 64-bit (×64) processor using an IEEE 1394b Firewire cable and a PCI express card with an IEEE 1394 port.

Allied Vision Technology software (universal package) was used for image capture. The trigger for image capture was controlled on the laptop using this software. The camera’s 200 fps speed and good image quality allowed us to analyze all the surgical steps with complete exactitude.

Validation of the Imaging Setup
A prospective observational interventional series was designed in 40 eyes of 40 patients with uncomplicated age-related cataract who had phacoemulsification at Iladevi Cataract and IOL Research Centre between August 2011 and October 2011. Patients with nuclear sclerosis grades 2 to 4 were included.

Incision construction was recorded in 20 eyes, 10 of which were performed by an experienced surgeon and 10 by one of 2 trainee surgeons. Quadrant removal was recorded in 20 eyes, all performed by 1 experienced surgeon.

For analysis, images were captured on the high-speed camera at 2 stages of phacoemulsification: incision construction (two 1.0 mm corneal paracentesis incisions as well as a 2.2 mm temporal clear corneal incision) and removal of divided nuclear quadrants after chopping (quadrant removal).

Surgical Technique
All surgeries were performed on the Infiniti Vision System (Alcon Laboratories, Inc.) using a standardized technique of microcoaxial phacoemulsification. A 0.9 mm miniflared 45-degree aspiration bypass system Kelman tip was used with an Ultrasleeve (Alcon Laboratories, Inc.). Torsional ultrasound was used in the burst mode in all eyes.

Incision Construction
A 1.0 mm corneal paracentesis incision was created using a 1.0 mm dual bevel disposable steel knife. A dispersive–cohesive ophthalmic viscosurgical device was injected through the paracentesis incision as per the soft-shell technique. Following this, a second corneal paracentesis incision was created 180 degrees from the first paracentesis incision. Next, a 2.2 mm single-plane temporal clear-corneal incision was made using a 2.2 mm disposable steel knife. A blunt spatula introduced through the paracentesis incision was used to stabilize the globe during incision construction.

Quadrant Removal
During quadrant removal, the divided quadrants were removed using standardized parameters in all eyes. The phaco tip was randomly used in 2 different orientations: In half the eyes, the tip was oriented vertically with the bevel facing upward and in the other half, it was oriented sideways with the
bevel facing sideward. Randomization was done using computer-generated tables. An unscrubbed nurse informed the surgeon of the tip orientation to be used.

Image Analysis
Images were captured at 200 fps. For the purpose of viewing and analysis, they were converted into a video at 30 fps and replayed as a slow-motion film (Pinnacle 14 software). The normal speed video of the corresponding segments of the surgery was also compared with the slow-motion film.

Analysis was performed for 2 stages of the surgery: (1) Incision construction: The paracenteses and the temporal incisions were analyzed for external entry, internal entry, travel inside the cornea, and exit from the cornea. Any dimpling of the cornea during entry into the anterior chamber, side cuts during exit, and visible egress of fluid with shallowing of the anterior chamber were noted. (2) Quadrant removal: The process of quadrant removal was analyzed for complete occlusion of the phaco tip during quadrant removal and position of the nuclear quadrants in relation to the phaco tip.

RESULTS

Incision Construction by Experienced-Surgeon
The slow-motion film showed that the paracenteses and the temporal incision were limbal (near clear corneal) and uniplanar. The paracentesis knife entered the anterior chamber in a single smooth motion, parallel to the iris. The knife exited in the same plane with no inadvertent sideways enlargement. There was minimal to no visible egress of fluid or shallowing of the anterior chamber.

Before the temporal incision was made, the incision site was located and the knife depressed on the sclera. As the knife advanced into the stroma, it was depressed and kept flush with the sclera. Entry into the anterior chamber was made in continuation of the same movement, without further depressing or changing the angulation of the knife. No dimpling was observed at the point of entry into the anterior chamber. The knife was withdrawn in the same plane, and there were no inadvertent sideways movements or sidecuts on the walls of the incision. Minimal egress was noted from the incision, with no anterior chamber shallowing.

Incision Construction by Trainee Surgeon
All the incisions looked similar to those of the experienced surgeon in the normal-speed video. However, in the slow-motion film, the following points were highlighted: In 3 eyes, there were tremulous movements and in 4 eyes, the movement was jerky. In 2 eyes, it was evident that the surgeon had changed the angulation of his knife before entering the anterior chamber, which led to dimpling. In 4 eyes, there was an inadvertent sideways movement of the knife
during exit, leading to an enlargement of the incision. Most of these points were not easily identifiable when the normal-speed video was analyzed.

Quadrant Removal When the bevel faced up, coring of the phaco tip into the lens material occurred more frequently. Whenever the phaco tip “cored” into the nuclear fragment, the fragment was divided into 2 sub-fragments, which lay on either side of the tip. More mechanical repositioning of the quadrants was required during removal. Whenever the tip was completed occluded, a plume of “lens milk” was seen floating around the phaco tip, obscuring visibility in the vicinity of the phaco tip.

When the phaco probe was rotated so the bevel of the tip faced horizontally, the tip was usually aligned parallel to the nuclear fragments during quadrant removal. The quadrant was emulsified predominantly by the surface shearing mechanism. Coring and complete occlusion of the tip were infrequent. As a result, less lens milk was seen than when the bevel was facing upward.

DISCUSSION

Use of high-speed imaging during incision construction highlighted the fact that exit from the eye is as important as entry into the eye. Typically, surgeons pay close attention while entering the eye, but they often do not pay the same amount of attention while exiting the eye. The incision can become enlarged during exit of the knife, which was demonstrated clearly on high-speed imaging. This may result in leaky incisions during surgery and affect induced astigmatism. Therefore, the surgeon should be equally careful while withdrawing the knife from the eye.

While analyzing quadrant removal, we observed that whenever there was complete occlusion at the tip, the emulsification action of the ultrasound continued without effective aspiration, resulting in a jet of emulsified lens being thrown out around the phaco tip in a plume-like fashion. These jets of plume were clearly visible in the slow-motion film compared to the normal-speed video. Further, we saw that complete occlusion and plumes occurred more frequently when the tip was vertical than when it was horizontal. High-speed imaging brought out the fact that the direction of the phaco tip bevel is an important part of the technique. Holding the phaco tip horizontally is better than holding it vertically, as there is less coring and the entire nuclear material is removed without breaking into subfragments, which would require additional manipulation with a second instrument.

Ultra-high-speed imaging has been used by a few investigators to understand the dynamics and mechanisms of phacoemulsification. However, all these studies were performed in a laboratory setting by simulating phacoemulsification. To our knowledge, this is the first report of the application of high-speed imaging in a real-time operating scenario during phacoemulsification.
We believe that this technology has manifold applications for the surgeon. Recording and reviewing high-speed images is a useful tool for teaching surgical steps to residents, fellows, and beginner surgeons. Apart from cataract surgery, it has applications for the vitreoretinal surgeons to understand the dynamics at the vitrector port with different cut rates. Further, it can be used in pseudophakic eyes to study the stability of IOLs, particularly phakic IOLs, iris-fixated IOLs, and intrasclerally fixated IOLs, with or without glue application. High-speed imaging can be used to evaluate new techniques and technology. Further, its application may be enhanced by the use of automation software to quantify the information obtained and thereby compare differences between techniques and technologies. This setup of high-speed imaging is user friendly and may be implemented in all teaching setups. However, we do acknowledge that high cost maybe a limitation for its universal application.

In conclusion, this technique of real-time high-speed imaging is easily applicable, requires minimal setup, and is user friendly. Expanding the use and applications of this technique will enhance our understanding of surgical techniques.

REFERENCES


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**Results and Complications of First 50 Eyes Operated with Femto-Second Laser Cataract Surgery**

**Dr. Charu Khurana, Dr. Mahipal Sachdev, Dr. Hemlata Gupta, Dr. Ramendra Bakshi, Dr. Triveni Grover**

Femto-second laser assisted cataract surgery has been commercially available since 2011 and has changed the way cataract surgery is performed across the world. As with the introduction of any new technique and technology, there has been a hesitation in adopting this over the more popular and universal phaco-emulsification technique of cataract surgery. We conducted this study to evaluate the results of the first 50 eyes treated with femto-laser assisted cataract surgery and to analyze the benefits, if any over conventional phaco-emulsification surgery.
MATERIALS AND METHODS

50 eyes of 32 patients were taken up for femto-phacoemulsification using the LenSx Femto-second laser. All surgeries were performed at Centre for Sight, Safdarjung Enclave, New Delhi by the authors and surgeons MSS, CK and HG who are already familiar with the femto-second laser and docking used for refractive surgery. Patients with non-dilating pupils, subluxated cataracts, glaucoma and post RK were excluded. Informed consent and approval of the ethics committee was obtained. The LenSx laser system (Alcon LenSx Lasers Inc., Aliso Viejo, CA) was used to perform femtosecond laser-assisted phaco-emulsification cataract surgery.

A comprehensive ophthalmic examination was performed pre-operatively including measurement of uncorrected and best corrected visual acuity, slit-lamp examination, intraocular pressure and fundus examination. IOL power measurement was performed using the IOLMaster (version 5; Carl Zeiss Meditech, Inc., Dublin, CA), and specular microscopy (EM-3000; Tomey, Nagoya, Japan) was done pre and post-op.

Standard pre-operative dilating drops and NSAIDs were administered as for routine cataract surgery.

The initial steps for the procedure involved selecting the capsulotomy size which was kept between 5.2 to 5.7 mm depending on the type of IOL being implanted and the pupil size. All primary incisions were placed on the steep axis while a secondary incision was placed 50-60 degrees away depending on surgeon preference. Lens chopping technique of quadrant or cylinder was selected based on the grade of nuclear sclerosis. Arcuate incisions were performed for refractive errors between 1–2 diopteres.

After all parameters were selected, the sterile patient interface (PI) of the LenSx laser system was docked onto the patient’s eye. When adequate applanation occurred the suction was applied and the markings on the live optical coherence tomography image verified including capsulotomy size and centration, primary, secondary and arcuate incision location and lens centration. The laser was then fired with the average duration of the laser being 45-57 seconds. Once the femto-second laser was complete the patient was shifted into the operating room. The secondary incision was opened, visco-elastic introduced into the anterior chamber and then primary incision opened. The capsulotomy was removed in a circumferential fashion if it was not complete taking care to avoid tags and leave incomplete areas for the end. A gentle hydro-dissection was performed and phaco-emulsification done along the pre-placed quadrants of the selected nuclear chopping lines. Irrigation and aspiration was completed and the IOL placed in the bag followed by visco-elastic removal. Standard post-operative antibiotic and steroid drops were administered for 4 weeks.
Intra-operative parameters including total phaco-time, total time spent in the operating room, capsulorhexis formation and removal, incision opening ease were measured. Post-op exam was performed 1 day, 1 week, 2 weeks, 1 month and 3 months later. UCVA and BCVA, slit lamp examination and specular microscopy was performed.

**RESULTS**

First 52 eyes of 32 patients (20 patients bilateral and 12 patients unilateral) were taken up for evaluation. 20 patients were male and twelve female. Age of the patients varied from 40 to 75 years with a mean age of 62.5 years. Average IOP was 17.8 ± 4.3 mm Hg and average axial length was 23.4 ± 2.5 mm

More than 2 docking attempts were made in 8 of the 52 eyes, 6 of which were in the first 10 eyes. The laser procedure and lens fragmentation including capsulotomy, primary, secondary and arcuate incisions was completed successfully in all patients. No case of iris bleed due to laser hitting the iris tissue occurred. Pupillary constriction was noted in 2 cases after docking in which case the capsulotomy was reduced from the planned 5.2 to 4.8 mm. The laser procedure was uneventful in all eyes with no case of suction loss during the laser firing procedure.

In the operating room, incision opening difficulty was seen in the first few cases as the plane was not identified correctly. Once familiarity with the Slade spatula and angulation was established, this did not recur. Arcuate incisions were performed in 12 eyes varying from 30 to 60 degrees in the opposite meridian of the primary incision.

Caspular tags and incomplete capsulotomy was seen in 5 of the first 10 eyes. One tag got pulled during irrigation and aspiration leading to a posterior capsular tear in which case the IOL was implanted in the sulcus. No case of nuclear drop was seen. Patients opted for Accomodative IOLs in 10 eyes, Multifocal in 12 eyes, Toric IOL in 6 eyes, Toric Multifocal in 2 eyes and monofocal aspheric in 22 eyes.

UCVA of >20/30 was seen in 100% eyes and 20/20 in 92% eyes (48/52). 76% (40/52) patients had 20/20 vision on first post-op day. Mild corneal edema was seen in 5 eyes which resolved within first 3 days. No case of IOP rise or CME were seen post-operatively beyond 3 weeks. No significant loss of endothelial cells was seen on specular microscopy between pre and post-operative values. While the average phaco-time was reduced due to laser fragmentation of the nucleus, the surgical time remained the same as routine case as Irrigation aspiration was slower. The overall time spent in the operating room was increased by 8-10 minutes on an average as the patient was shifted from the Laser room to the operation theatre.
**DISCUSSION**

Femto-second lasers have brought a revolution in ophthalmology with their multiple used in refractive surgery, penetrating keratoplasties and intra-corneal ring segments among many others. Introduction of the femto-second laser for cataract surgery is a fascinating technique as it targets the very basics of an ophthalmic practice. With its greater precision and accuracy, femto-second lasers are targeted at making cataract surgery similar to a refractive procedure and reduce the complication rate.

This study analyses the results of the first 52 eyes in a tertiary care centre in New Delhi. Our results are slightly better than those reported in literature as all 3 surgeons were well versed with the femto-second laser docking system used for refractive surgery.¹

Signs of a creeping meniscus, conjunctival encroachment or nasal interference were quickly dealt with before firing the laser and no procedure was incomplete or abandoned mid way. The number of docking attempts was reduced as experience was gained. Narrow palpebral apertures still took longer to dock successfully in one attempt. No suction loss seen in our cases while the laser was fired indicated good suction placement and stability due to previous experience.

Intra-operatively, the triplanar geometry of the incision needs to be remembered as the incision has to be first opened vertically and then obliquely to enter the anterior chamber. This took some time to get used to but the Slade spatula was a handy instrument. Arcuate incisions were made to tackle co-existing astigmatism in 12 eyes while patients with more than 2 D of astigmatism were advised Toric IOLs. An interesting observation was that more patients opted for advanced technology (AT) IOLs when going in for Femto-phaco cataract surgery as they wanted premium results. 57.7% patients chose AT IOLs in our series which is a significantly high number compared to routine phacoemulsification cases.

Incomplete capsulotomies and anterior capsular tags were seen in 5 of the first 10 cases. This issue was resolved by reducing the anterior offset from 300 to 150 microns as it resulted in more efficient delivery system to the anterior capsule and less creation of incomplete areas. Also pupil constriction due to laser energy hitting the iris tissue was reduced. One PC tear occurred as an incomplete tag was pulled and extended to the PC during IA. No PC tear was seen in the last 40 eyes as surgical experience improved. Irrigation and aspiration took longer as the cortex removal is different and needs to be slower. No capsular block or posterior capsular blowout or nucleus drop was seen in any of our cases.
Overall UCVA on day 1 was 20/20 in 76% cases and on 2 weeks in 92% cases. This can be attributed to better wound architecture and tackling of co-existing astigmatism, greater use of AT IOLs, customized and regular capsulotomies and reduced phaco-time due to lens fragmentation with the laser. The complication rate with surgeons familiar with femto-second lasers is lesser and the learning curve shorter.

Femto-second laser assisted cataract surgery offers improved results after a short learning curve. Improved UCVA and BCVA, short phaco-time, tackling of co-existing astigmatism and reduced endothelial cell loss are advantages. Longer follow up in greater number of cases is needed to fine tune this technology for easier and widespread use.

REFERENCES
similar, but the damage to other ocular tissues due to trauma may compromise the visual gain in eyes operated on for traumatic cataracts. Hence, the success rates may differ between eyes with these two types of cataract.

With the introduction of the Birmingham Eye Trauma Terminology System (BETTS), the documentation of ocular trauma has been standardized. Post operative inflammation Is a common complication following traumatic cataract. We have divided a study group with posterior capsulectomy with anterior vitrectomy as a primary procedure, irrespective of primary opening in posterior capsule is present or not and a control group.

Our study was conducted in a city located at the borders of three states in India: Gujarat, Madhya Pradesh, and Rajasthan. Qualified ophthalmologists at our institute provide low-cost eye services mainly to the poor belonging to the tribal population of 4.2 million in this area.

**MATERIALS AND METHODS**

We obtained approval from the hospital administrators and research committee to conduct this study and received the participants’ written consent.

This was a prospective study designed in 2002. All traumatic cataracts in either eye diagnosed and managed between January 2003 and December 2009 were enrolled in our study, and those consenting to participate and not having other serious body injuries were included.

For each patient enrolled in our study, we obtained a detailed history, including details of the injury and information on eye treatment and surgery performed to manage past ocular trauma. Data for both the initial and follow-up reports were collected using the online BETTS format of the International Society Ocular Trauma. Details of the surgery were also collected using a specified pre-tested online form.

The cases of traumatic cataract were grouped as those with open or closed globe injuries. The open globe injuries were further categorized into those with lacerations versus rupture. Lacerations of the eyeball were subcategorized into eyes with perforating injuries, penetrating injuries, or injuries involving an intraocular foreign body. The closed globe group was subdivided into lamellar laceration and contusion.

As this is our primary purpose to study this predictor, we have also grouped cases in two groups whether primary posterior capsulectomy and anterior vitrectomy performed or not on ground of vitreous haze irrespective of presence of opening in posterior capsule.

Other demographic details collected included entry of the patient, residence, activity at the time of injury, object of injury, and previous examinations and
treatments. After enrollment, all patients were examined using a standard method. Visual acuity was checked using Snellen’s chart, and the anterior segment was examined using a slit lamp.

Based on lenticular opacity, the cataracts were classified into total, membranous, white soft, and rosette types. When an ophthalmologist did not observe clear lens matter between the capsule and nucleus, the cataract was defined as total. When the capsule and organized matter were fused and formed a membrane of varying density, it was defined as a membranous cataract. When loose cortical material was found in the anterior chamber together with a ruptured lens capsule, the cataract was defined as white soft. A lens with a rosette pattern of opacity was classified as a rosette type cataract.

For a lens that was partially opaque, the posterior segment examination was carried out with an indirect ophthalmoscope and a +20 D lens. When the optical medium was not clear, a B-scan was performed to evaluate the posterior segment.

The surgical technique was selected according to morphology and the condition of tissues other than the lens. Phacoemulsification was used to operate on cataracts with hard, large nuclei. With a lens that had either a white soft or rosette type of cataract, unimanual or bimanual aspiration was used. Membranectomy and anterior vitrectomy, either via an anterior or pars plana route, were performed when the cataract was membranous.

In all patients undergoing corneal wound repair, the traumatic cataract was managed in a second procedure. Recurrent inflammation was more prominent in patients who had undergone previous surgery for trauma. In such cases, the ocular medium will turn hazy due to condensation of the anterior vitreous unless a vitrectomy is performed. Hence, we performed a capsulectomy and vitrectomy via an anterior/pars plana route in adults.

In children younger than 2 years of age, both lenectomy and vitrectomy via a pars plana route were performed, and the same surgical procedures were used to manage the traumatic cataract. Lens implantation as part of the primary procedure was avoided in all children younger than 2 years of age.

All patients with injuries and without an infection were treated with topical and systemic corticosteroids and cycloplegics. The duration of medical treatment depended on the degree of inflammation in the anterior and posterior segments of the operated eye. The operated patients were re-examined after 24 h, 3 days, and 1, 2, and 6 weeks to enable refractive correction. Follow-up was scheduled for the third day, weekly for 6 weeks, monthly for 3 months, and every 3 months for 1 year.

At every follow-up examination, visual acuity was tested with Snellen’s chart. The anterior segment was examined with a slit lamp; and the posterior
segment, with an indirect ophthalmoscope. Eyes with vision better than 20/60 at the glasses appointment (6 weeks) were defined as having a satisfactory grade of vision.

During the examination, data were entered online using a specified pretested format designed by the International Society Ocular Trauma (initial and follow-up forms) that was exported to a Microsoft Excel spreadsheet. The data were audited periodically to ensure completion. We used the Statistical Package for Social Studies (SPSS 15) to analyze the data. The univariate parametric method was used to calculate frequency, percentage, proportion, and 95% confidence interval (95% CI). We used binominal regression analysis to determine the predictors of postoperative satisfactory vision (>20/60). The dependent variable was vision >20/60 noted at the follow-up 6 weeks after cataract surgery. The independent variables were age, gender, residence, time interval between injury and cataract surgery, primary posterior capsulectomy and vitrectomy procedure, and type of ocular injury.

RESULTS

Our cohort consisted of 687 (72.2%) patients with traumatic cataracts. There were 496 eyes with open globe ocular injuries and 191 (27.8%) eyes with closed globe injuries. The patients included 492 (71.6%) males and 195 (28.4%) females. The mean patient age was 27.1 ± 18.54 years (range, 1–80).

Our study group had 182 and control group had 505 cases.

We analyzed several demographic factors, including patient entry (p = 0.4), socioeconomic status-79% were from poor class, and residence-95% rural area and none had a significant relationship with the final visual acuity, according to cross tabulation and statistical tests. The object causing the injury (p = 0.3) and the activity at the time of the injury (p = 0.3) were also not significantly associated with satisfactory final visual acuity.

<table>
<thead>
<tr>
<th>Final Visual acuity</th>
<th>No</th>
<th>Yes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Un Cooperative</td>
<td>13</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>&lt;1/60</td>
<td>112</td>
<td>59</td>
<td>171</td>
</tr>
<tr>
<td>1/60 to 3/60</td>
<td>35</td>
<td>21</td>
<td>56</td>
</tr>
<tr>
<td>20/200 to 20/120</td>
<td>46</td>
<td>18</td>
<td>64</td>
</tr>
<tr>
<td>20/80 to 20/60</td>
<td>102</td>
<td>43</td>
<td>145</td>
</tr>
<tr>
<td>20/40 to 20/20</td>
<td>186</td>
<td>37</td>
<td>223</td>
</tr>
<tr>
<td>Total</td>
<td>494</td>
<td>182</td>
<td>676</td>
</tr>
</tbody>
</table>

X² test, p=0.001, ANOVA p=0.000
### Table 2: Primary Posterior capsulotectomy in relation with type of injury

<table>
<thead>
<tr>
<th>Type of Injury</th>
<th>Not done</th>
<th>Done</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed globe</td>
<td>141</td>
<td>50</td>
<td>191</td>
</tr>
<tr>
<td>Open globe</td>
<td>364</td>
<td>132</td>
<td>496</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>505</td>
<td>182</td>
<td>687</td>
</tr>
</tbody>
</table>

*X2 test, p=0.495*

### Table 3: Primary Posterior capsulotectomy in relation with sub types of Open globe injury

<table>
<thead>
<tr>
<th>Type of Injury-Open globe</th>
<th>Not done</th>
<th>Done</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Globe Rupture</td>
<td>24</td>
<td>22</td>
<td>46</td>
</tr>
<tr>
<td>Penetrating injury</td>
<td>320</td>
<td>102</td>
<td>422</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>344</td>
<td>124</td>
<td>468</td>
</tr>
</tbody>
</table>

*X2 test, p=0.001*

### Table 4: Number of surgical procedures for particular eye in case of primary posterior capsulectomy and vitrectomy done or not done

<table>
<thead>
<tr>
<th>Number of Surgical Procedure</th>
<th>Not done</th>
<th>Done</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>446</td>
<td>138</td>
<td>584</td>
</tr>
<tr>
<td>2.00</td>
<td>55</td>
<td>39</td>
<td>94</td>
</tr>
<tr>
<td>3.00</td>
<td>4</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>505</td>
<td>182</td>
<td>687</td>
</tr>
</tbody>
</table>

*X2 test, p=0.000*

### Table 5: Complications compared in case study and control group

<table>
<thead>
<tr>
<th>Name of complication</th>
<th>Total</th>
<th>Not Done</th>
<th>Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Wound leak</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2 Hyphema</td>
<td>10</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>3 Iridodialysis</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5 IOL Mal position</td>
<td>17</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>6 Vitreous Loss</td>
<td>15</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>7 Infection</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8 Corneal edema</td>
<td>28</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>11 Inflammation</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>12 Glaucoma</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>13 Retinal Detachment</td>
<td>13</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>14 After cataract</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>15 Other</td>
<td>59</td>
<td>36</td>
<td>23</td>
</tr>
</tbody>
</table>

*X2 test, p=0.002.*
Final visual outcome found to have stastically significant difference in study group. X2 test, p=0.001, ANOVA p=0.000 (Table-1).

We have studied relationship with type on injury as well as subgroups of open globe injury by BETT (Table-2) and (Table-3).

We have compared number of surgeries performed in both groups we found significant difference. X2 test, p=0.000 (Table-4).

Incidence of complications significantly different in both group. X2 test, p=0.000 (Table-5).

DISCUSSION

Post operative intraocular inflammation is one of major complications seen following surgical procedure of traumatic cataract.6,7,8,9,10,11

We have performed primary posterior capsulectomy and anterior vitrectomy as a primary procedure, in all age groups. Similar procedure performed for traumatic cataract reported by Rastogi et. al.11 and Kumar et. al.12 they found similar results but only in pediatric age group.

When we studied relationship with type of injury no difference was found amongst open globe and closed globe group (p=0.495) (Table-2) but significant difference found amongst sub groups of open globe injury. (p=0.001) (Table-3)

We did not find this type of finding in any study.

We have also seen that primary procedure in study group has reduced number of surgical procedures (p=0.004) (Table-4) we did not find any such study in literature.

We could see that complication rate is significantly less in study group (p=0.002) we could not find any study to compare this in literature. Incidence of retinal detachment is less in study group.

In conclusion primary posterior capsulectomy with anterior vitrectomy may be used as a useful tool for better final visual outcome particularly if posterior segment inflammation is more.

REFERENCES

4. Shah M, Shah S, Khandekar R. Ocular injuries and visual status before and after
Pseudoexfoliation (PXF) as a Risk Factor for Intraoperative Complications During Cataract Surgery

Dr. Haripriya Aravind, Dr. R Ramakrishnan, Dr. Sathyan Parthasarathi, Dr. Rengaraj Venkatesh, Dr. Madhu Sekhar, Dr. Alan Robin

Pseudoexfoliation syndrome (PXF) is an age related disorder of extracellular matrix characterized by an accumulation of fibrillar extracellular material in ocular tissues. The prevalence of both PXF and cataract increases with age. Therefore many eyes with PXF will require cataract surgery.

The problems faced during cataract surgery due to PXF include small pupil, intraoperative complications such as zonular dialysis, capsular rupture, vitreous loss and posterior nuclear dislocation. The incidence of post-operative complications is also increased; which may be early such as increased incidence of inflammation or late like spontaneous dislocation of intra-ocular lens and even capsular tension ring with intraocular lens.

PXF has been seen in almost all areas of the world and is also a common occurrence in South India. According to the Aravind Comprehensive Eye Survey of PXF in a rural population of Southern India the prevalence of PXF...
over the age of 40 years is approximately 6%. Its prevalence increases with age and has predominance in the male population. In the survey PXF was found to be in 25.7% of bilaterally blind patients; 89.3% of these were blind from cataracts. 7.5% had glaucoma and 26.7% of these had primary open angle glaucoma.

The purpose of the study was to describe the intraoperative and immediate postoperative complications of cataract surgery in eyes with PXF, to determine the natural course of the changes in the capsular bag in PXF following cataract surgery with CTR and various IOLs; and to develop evidence based methods to minimize early and late IOL dislocation and subluxation complications.

**MATERIALS AND METHODS**

A prospective, multicenter, randomized controlled trail at 4 centers within the Aravind Eye Care System was done from January 2011 to April 2012. All patients included in the study underwent LOCS III grading, PXF grading, specular microscopy, Humphrey perimetry, intraocular pressure and dilated fundus examination. The patients were randomized into those with visually significant cataract and coexistent PXF; and without PXF undergoing cataract surgery which was the control group. The patients in Cataract with PXF group were further subdivided into 4 groups i.e. A B C D with 250 patients each. The patients in group A received SA60AT single piece acrylic lens with CTR, group B received the same lens without CTR, group C MA60AC three piece acrylic lens with CTR and Group D also received MA60AC without CTR. The control group was divided in two groups i.e. E and F. Group E constituted of 251 patients implanted with SA60AT single piece acrylic without CTR and group F had 249 patients with MA60AC three piece acrylic lens without CTR.

Patients between 40 and 75 years, PXF requiring cataract surgery, with or without secondary open angle glaucoma and endothelial cell count >1500 were included in the study.

The exclusion criterion included inability to give informed consent, patients who had prior intraocular surgery, phacodonesis, low endothelial cell count, medically uncontrolled IOP/ glaucoma and any pre-existing ocular pathologies other than cataract and glaucoma.

The patients were followed up postoperatively on 1 day, 1 month, 3 months, 6 months, 1 year and annually for the next 10 years. 18 surgeons in 4 centers of the Aravind Eye Care System performed cataract surgery in these patients. Temporal clear corneal incision, 4.5 to 5.5 mm capsulorhexis and phacoemulsification by the phaco chop or stop and chop technique was done in all patients.
RESULTS
The mean age of patients (1000 eyes) in cataract with PXF group was 63 years as compared to 58.2 years in patients (500 eyes) of cataract without PXF group; with a statistically significant p value of < 0.001. The eyes in cataract with PXF group had a mean IOP of 14 mmHg; SD 3.0 mmHg as compared to 14.4 mmHg; SD 3.3 mmHg in the cataract without PXF group; with a statistically significant p value of 0.02. Grade 3+ nuclear sclerotic cataracts was found in 65% of eyes in cataract with PXF group as compared to 50% of eyes in cataract without PXF group; with a p value of <0.001.

The intraoperative complications included zonular dialysis without vitreous loss, posterior capsule rupture without vitreous loss, zonular dialysis or posterior capsule rupture with vitreous loss and posterior nuclear dislocation. Overall intra-operative complications occurred in 2% of eyes in cataract with PXF group as compared to 1.2% of eyes in cataract without PXF group; this difference was not statistically significant.

Reoperations were required in 5 eyes which is 0.5% in study group; while there were no reoperations in the control group. With a p value of 0.176 this difference was not statistically significant. Duration of surgery of less than 15 minutes in 929 of 1000 study eyes (92.9%) as compared to 466 of 500 eyes (93.2%) in cataract without PXF group.

Follow up on post operative day 1 showed a BCVA of 6/6 – 6/18 in 947 of 1000 eyes (94.7%) and 489 of 500 eyes (97.8%) in the cataract with PXF group and cataract without PXF group respectively; p value of 0.005. The IOP was 13.6 (4.9%) as compared to 13.4(4.6%); with a p value of 0.59. No or mild corneal edema was present in 903(90.6%) eyes as compared to 474(94.8%); with a p value of 0.004.

Follow up on post operative day 30 showed a BCVA of 6/6 – 6/18 in 980 of 1000 eyes (99.9%) and 483 of 500 eyes (99.8%) in the cataract with PXF group and cataract without PXF group respectively. The IOP was 13.57 (3.49%) as compared to 13.6(3.38%); with a p value of 0.89. No or mild corneal edema was present in 979(99.9%) eyes as compared to 484(100%); with a p value of 0.643.

In conclusion it is the first large scale prospective study evaluating South Indian eyes with PXF undergoing phacoemulsification. The eyes with PXF were older and had denser cataracts than subjects without PXF. Eyes with PXF without preexisting phacodonesis do not differ from control eyes with regard to intraoperative complications. No differences were detected in complication rates or the duration of surgery when phacoemulsification was performed by experienced surgeons irrespective of IOL type or use of a CTR. On day 1, there was a slight difference between groups with the PXF group having slightly
more corneal edema and correspondingly slightly worse best corrected visual acuity. However, by one month there were no significant inter-group differences with almost 100% having vision better than 6/18 and no corneal edema.

Continuing follow up is required to determine what preoperative factors lead to dislocation of IOLs and development of glaucoma.

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**Trypan-Blue Injection into Capsular Bag: Initial Results of Post-operative PCO in a Randomized Clinical Trial**

**Dr. Pankaj Sharma, Dr. Mahima PANWAR**

Posterior Capsular Opacification (PCO) still remains a major concern as the single most important late complication after uneventful cataract surgery leading to decrease in quality of vision. Though the treatment is simple and quick with YAG Laser, the procedure entails the risk of significant posterior segment complications and added financial burden. Proliferation and Epithelial-to-Mesenchymal transformation (EMT) of Lens Epithelial Cells (LECs) is the main cause of progressive opacification of posterior capsule.

Trypan blue is a vital dye used extensively in Ophthalmology and studies have shown its significant effect on Lens Epithelial Cells (LECs). However, in these studies, the dye was used on the outer surface of the lens. The purpose of the present study, the first of its kind, was to attempt to directly relate the cause of PCO (LECs) to the effect (PCO).

**MATERIALS AND METHODS**

This prospective, randomized, patient and observer masked clinical trial comprised 300 eyes undergoing phacoemulsification for senile cataract. Patients having any condition predisposing to higher PCO rate were excluded (recent or past intraocular inflammation, pseudoexfoliation, diabetes, trauma, glaucoma, age group <40 yrs., previous ocular surgery). Patients with posterior polar cataracts were also excluded as routine hydrodissection was not performed.

Eyes were randomized to one of two groups

- **Group A** (case, n=150), in which 0.2ml of 0.1% trypan blue (Visiblue® by Shah & Shah, Calcutta) was injected subcapsularly at two sites 180 degrees apart following cortical cleaving hydrodissection;
- **Group B** (control, n=150) in which
0.2ml balanced salt solution (BSS) was injected in a similar fashion. Thus the control group received a second injection of BSS after cortical cleaving hydrodissection to match the total fluid used in the bag in both the groups. Foldable, hydrophilic acrylic, square edge IOL (CT ASPHINA® 603P) was implanted with a wound assisted delivery.

Post-Operative Follow-up
All patients were followed up as per the usual protocol of cataract surgery. This included BCVA, and Slit lamp examination on day 1, day 7, 1 month, 6 months, and 12 months. Special follow up for assessment of PCO was done by a masked observer (M.P.). After maximal pupillary dilatation, digital retroillumination image of the eye was recorded on slit lamp at 6 and 12 months post-operatively. Care was taken to keep the slit small and as peripheral as possible so as to get a clear visualization of as much of the capsule behind the IOL optic as possible. This image was loaded on a Windows-based, public domain, open source software (Imagej, NIH). Setting the scale to the IOL optic size (6.0 mm), the total area of the capsule behind the IOL optic was calculated. PCO grading was done as described by Tetz et. al. Using the Image J software, area of particular PCO grade was enclosed. The actual area of this enclosure was obtained and reduced to the percentage of the total area calculated in the first step. This was multiplied with the PCO grade. PCO score of all such areas was summated to obtain the total PCO score

\[ \text{PCO score} = \sum \left( \text{fraction area} \times \text{PCO grade (0 to 4)} \right) \]

The results of Groups A and B were statistically analyzed using the paired t-test. At the end of the study, the numbers of patients requiring YAG Laser capsulotomy for significant central PCO were also noted. Chi square test was used to find statistical significance for YAG capsulotomy rates between the two groups. The BCVA was recorded and logMAR was compared between the two groups at the end of one year.

RESULTS
Of the 300 consecutive eyes recruited, the study was completed for 102 and 103 eyes in Groups A and B respectively. The mean age of patients in the groups was 62.79 ± 8.89 years and 63.69 ± 9.20 years respectively. All the patients in both the groups were above the age of 45 years and the maximum age in the two groups was 85 and 92 respectively. There were 56 males and 46 females in Group A and 51 males and 52 females in Group B. In Group A, the mean PCO score obtained was 0.10 with a standard deviation of 0.191. In Group B, the mean PCO score was 0.21 with a standard deviation of 0.326. This result was statistically significant (p=0.0418).

At the end of 12 months, PCO scores were again calculated. In Group A, the mean PCO score was 0.15 with a standard deviation of 0.264. In Group B, the mean PCO score was 0.25 with a standard deviation of 0.378. This result was
also statistically significant with an increased level of significance from the 6 month follow up (p=0.0227).

At the end of 12 months, 2 eyes from the treated Group A required Nd:YAG laser capsulotomy for significant central PCO (1.96%) as compared to 6 eyes in the control Group B (5.83%). Using the chi square test, the difference was not statistically significant (p= 0.1489).

The BCVA was compared between the two groups at the end of the study. The average logMAR in the treated group was 0.04 as compared to 0.07 in the control group (p=0.121).

**DISCUSSION**

Nanavaty _et. al._ first studied the effects of staining of anterior capsule on LECs. They showed a significant decrease in LEC density (HE Stain) and viability (Phase Contrast microscopy) in capsules treated with trypan blue. Portes _et. al._ similarly studied capsules stained with trypan blue. They showed a significant difference in perimeter to area ratio and greatest to smallest nuclear axis ratio of LEC, in the treated group, using Transmission Electron Microscopy. All previous studies, whether clinical or lab models, have used the dye for staining the outer surface of the intact anterior capsule. Trypan blue was injected just after cortical cleaving hydrodissection and nuclear rotation with an aim to have a maximal equatorial contact without significant dilution by the anterior chamber fluid. Phacoemulsification was commenced and nucleus disassembly with the direct chop technique resulted in rapid egress of dye from the capsular bag and return of the red reflex. Thus the average contact time of the dye to the capsular fornix was about 30 seconds.

Significantly less average PCO score was noted both at 6 months and 12 months in the treated group. Our findings support the suggestion that the use of trypan blue may help prevent proliferation of LECs after cataract surgery and thus reduce the incidence of PCO. Although further studies with a larger sample size and longer follow-up are required, the study gives initial results in a clinical setting favouring the use of trypan blue to reduce the development of PCO.

**REFERENCES**


Result of IOL Power Calculation by Haigis- L Formula after Post Refractive Surgery (Lasik) for Myopia

Dr. Niraj Agrawal, Dr. Vinayak Kumar, Dr. Haripriya Aravind, Dr. Puja Bhuwania

Excimer laser keratectomy (LASIK) has become the modality of choice for corneal refractive surgery. Cataract surgery after corneal refractive surgery is challenging due to difficulty with accurate intraocular lens power determination and unexpected “refractive surprise”. Hence problems are encountered in treating the increasing number of patients who have had refractive corneal surgery and are now developing a cataract. In past few years, increasing attention has been given to this problem. Basically, three main sources of error has been identified as inaccurate corneal radius measurement (radius error), use of virgin corneal keratometric index to calculate corneal power (keratometric error) and intraocular lens formula (erroneous lens position). Many strategies had been adopted to improve the accuracy of biometry measurement with varying degree of ease of use. Though refractive history method is still the gold standard but in absence of previous data, methods relying on the current measurements only are more important. One such formula, Haigis-L is included in the operating software of IOL master (version 4.xx), which works well for biometry in post refractive surgery for myopia. The Haigis formula developed by W. Haigis does not use corneal power as a predictor for post-operative effective IOL position, hence reducing the risk of formula error. Haigis-L formula has been in use for about 5 years and is based on the Haigis formula, with adjustment made for the post-myopic refractive surgery corneal radius (derived from IOL Master measurement), according to the formula rcorr = 331.5 / (-5.1625 x rmeas) + 82.2603 - 0.35, where rcorr is the corrected corneal radius of curvature and rmeas is the measured corneal radius of curvature. This study aims to assess the results of intraocular lens power calculation in post refractive cataract surgery for myopia using the Haigis-L formula.

MATERIALS AND METHODS

Retrospective case series of all post- refractive surgery (LASIK), cataract operations at Aravind Eye Hospital, Madurai from November 2010 to March 2012. Pre refractive data was not available in all cases. The postoperative results of 12 consecutive cases of phacoemulsification and intraocular implantation post-refractive surgery (LASIK) with a targeted myopic refraction were analysed. Input data were from current IOL Master (version 4, xx) biometry as follows: axial length (AL), anterior chamber depth (ACD) and keratometry.
(corneal radii) measurements. Three IOL types were implanted as follows: Alcon SN60WF; Alcon SA60AT and Aurofold B3602. Post-operative refraction was done, at day 1 and day 30.

**Statistical Analysis**

The statistical analysis was performed by STATA 11.0 (Corp college station Tx. USA). After collection of data using Excel 2000 (Microsoft Corp.), the continuous variable of age, spherical equivalent, axial length, anterior chamber depth, arithmetic error, absolute errors are described as mean, standard deviation and range.

**RESULTS**

Current IOL Master biometry and keratometry data (Post refractive surgery for myopia and before cataract surgery) and stable manifest refractions (best corrected distance acuity) after IOL implantation were measured. The respective mean values were as - patient age (n = 12) 41 +/- 8.56 years (range 29 to 56 years); AL 29.32 +/- 2.50 mm (range 25.40 to 32.43 mm); ACD 3.34 +/- 0.38 mm (range 2.74 to 3.78 mm); and spherical equivalent (SE) of stable refraction - 2.65 +/- 2.40 D (range – 7.0 to +1.5 D). The results obtained were the mean arithmetic refractive error – 0.01 +/- 1.24 D (range – 1.24 to+2.88 D), the mean absolute refractive error +0.93 +/- 0.77 D (range +0.12 to + 2.88 D) and the median absolute refractive error is 0.91 D. The percentages of correct refraction predictions within +/-2.00, +/-1.00, and +/-0.50 D were 91.66%, 50% and 33.33% respectively.

**DISCUSSION**

Laser vision correction was introduced in 1980’s. By now many of the early patients who underwent refractive surgery have reached an age when cataracts are formed. Therefore an accurate method for selecting IOL power will be increasingly important. According to bench mark standards proposed by British-NHS (2009)2 for normal cornea cataract surgeries, 55% of cases should be within +/- 0.5D and 85% +/- 1D of targeted spherical equivalent, while no such guidelines are available for post refractive surgeries as for now. Literature review showed paucity of studies reporting the results for using Haigis-L in post refractive surgeries. Our results for mean arithmetic error (-0.01 +/- 1.24 D) and mean absolute error (+0.93 +/- 0.77 D) are not as accurate as results of study done by Haigis *et. al.* (2008)1, (ME -0.04 +/- 0.70D, MA +0.51 +/- 0.48D). This may be due to a small sample size. It is similar to results by Singapore national eye center (2009) (ME -0.57 +/- 0.78D, MA +0.81 +/- 0.51D). Although the above mentioned studies were done with mixed group of PRK and LASIK patients, our study includes only LASIK patients. Study published in American Academy of Ophthalmology (2011, Martin Mccarthy *et. al.*3)
found 5 most accurate methods for IOL power calculation in post refractive surgeries as Haigis-L, Masket with Hoffer Q, Shammas.cd with Shammas-PL formula, clinical history method with Hoffer Q and Latkeny flat-K with SRK\T predicted between 70 to 85% of eyes within +/- 1D of targeted refraction. Our study showed 50% accuracy within +/-1D but absence of a need of preoperative data should be considered as the ease of use and absence of the potential source of error. Haigis-L uses the presumption of average posterior corneal curvature of all patients, which can be a source of error in post refractive surgeries. A study by Maolong Tang et. al. in JCRS (2012) showed that the use of OCT based IOL power calculation (which also takes into account the posterior corneal curvature) gives similar results to regression optimised post refractive IOL formulae like Haigis-L. Limitation of our study is the smaller sample size which needs a larger case series for confirmation.

The Haigis- L formula used for post refractive surgery IOL power calculation provided promising results in eyes without pre refractive data.

REFERENCES