

Study of Post-Operative Complications of Phacoemulsification and its Visual Outcome in Chidambaram, Tamil Nadu

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Abstract

Background: Cataract remains the leading cause of curable blindness in the world. In India, Cataract is responsible for 50-80% of the bilaterally blind. At present Phacoemulsification is fast growing in popularity and is opted as a surgery of choice for cataract extraction due to its various advantages. But phacoemulsification has its own share of complications and a long learning curve. This study is focussed upon the post-operative complications of phacoemulsification.

Methods: This is a prospective study of a group of 50 patients who underwent Phacoemulsification at Rajah Muthiah Medical College Hospital, Chidambaram, Tamil Nadu from May 2011 to May 2013. The patients were classified based on type of cataract. Thorough pre-operative examination was done by slit lamp bio-microscopy, indirect ophthalmoscopy and OTI B Scan Ultrasonography. The exclusion criteria included significant corneal opacification, uveitis, pre-existing glaucoma and pre-existing posterior segment disorders. The keratometry and IOL power were calculated using OTI/Sonomed A Scan. The surgical techniques were performed under local anaesthesia. Phacoemulsification was done with the Appasonic Galaxy I phaco emulsifier system. Post operatively the patients were assessed on 1st day, 1st week, 1st month and after 6 months. On every visit, BCVA (Best Corrected Visual Acuity) was assessed and slit lamp examination was done. Keratometry readings were taken on the 6th month visit to assess post-operative astigmatism by comparing them with pre-operative keratometry readings.

Results: Surgically induced corneal astigmatism had a general shift towards ATR (Against The Rule). Incisions of 2.8 mm length were least astigmatic than 6mm incisions. The group showed preponderance to a lesser degree of astigmatism with incisions closer to the limbus.

Conclusions: The study showed that post-operative astigmatism and inflammation were minimal. Visual recovery and patients' rehabilitation were accelerated with phacoemulsification.

Keywords: Cataract, phacoemulsification, Keratometry, Astigmatism.

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Introduction

The crystalline lens is a highly organized transparent structure that has evolved to alter the refractive state of the light entering the eye. Cataract is defined as any opacity in this

lens or its capsule, whether developmental or acquired, stationary or progressive, causing visual impairment.

Cataract remains the leading cause of curable blindness in the world (47.8%) [1]. In India, cataract has been reported to be responsible for 50–80% of the bilaterally blind [2]. India accounts for about 4 million new cases of cataract annually with a back-log of more than 12 million cases. Cataract surgery is done for such people with the aim of them achieving better, unaided visual acuity with rapid post-surgical recovery and minimal surgery related complications. There was a need for good quality cataract surgery around the world and into every part of society to achieve the goals of the Vision 2020 program.

In February 1967, Charles Kelman propounded the view that the ultrasonic tool used at that time by some dentists to help descale teeth, could also be used to fragment the nucleus of the crystalline lens and its removal without the need for a large incision [3]. But the equipment involved was large, inefficient and extremely heavy. Phacoemulsification offers the surgeon, the possibility to break the nucleus into smaller and even into fine emulsion of material, all of which can be removed through the probe which was used to break up the nucleus. At that time, the patients were either left aphakic or the incision needed considerable enlargement to allow insertion of then relatively new, rigid intra ocular lenses. The developments in the surgical techniques (particularly continuous curvilinear capsulorhexis) and the development of high quality foldable IOL (Intra Ocular Lenses) acted synergistically to enable the development of modern Phacoemulsification surgery.

Phacoemulsification is fast growing in popularity and is opted as a surgery of choice for cataract extraction due to advantages of less post-surgical astigmatism, earlier stabilisation of refraction, improved visual acuity and better patient compliance.

Like any other surgical procedure, phacoemulsification has its own share of complications and a long learning curve despite which it has already become the procedure of choice in the present decade. The study is focussed upon the post-operative complications and the final visual outcome following the phacoemulsification technique done at Rajah Muthiah Medical College and Hospital (RMMCH), Annamalai University, Chidambaram, Tamil Nadu, India.

Aims and Objectives

1. To study the post-operative complications of Phacoemulsification.
2. To evaluate the visual outcome in patients undergoing Phacoemulsification.

Methods

This is a prospective study of a group of 50 cases, who have undergone Phacoemulsification at Rajah Muthiah Medical College and Hospital (RMMCH), Annamalai University, Chidambaram, Tamilnadu, India. These patients were classified as immature, mature, hyper-mature, nuclear and posterior sub-capsular cataract. Thorough pre-operative evaluation of the anterior segment of the eyes was done by slit lamp bio-microscopy and posterior segment by indirect ophthalmoscopy and OTI B Scan Ultrasonography. The cases with pre-existing posterior segment disorders were excluded from the study. The other exclusion criteria included significant corneal opacification, uveitis, pre-existing glaucoma or previous intra-ocular surgery in the same eye. The keratometry and IOL power were calculated using OTI/Sonomed A Scan.

Inclusion Criteria

1. Cortical cataract
2. Immature
3. Mature
4. Hyper mature
5. Nuclear cataract

6. Posterior Sub-capsular cataract

Exclusion Criteria

7. Paediatric age group
8. Traumatic and Complicated Cataracts
9. Cataract with pre-existing Glaucoma
10. Cataract with posterior segment opacities
11. Significant corneal opacities
12. Previous intra-ocular surgery
13. Pupil not dilating > 7mm

Preoperatively, the pupils were dilated by instilling 1% Tropicamide and 0.03% Flurbiprofen eye drops. The surgical techniques were performed under either peribulbar or subtenon's anaesthesia. Phacoemulsification was done with the Appasonic Galaxy I peristaltic phacoemulsifier system of Appasamy. Post operatively the patients were assessed on 1st day, 1st week, 1st month and after 6 months. On every visit, (Best Corrected Visual Acuity) BCVA was assessed and slit lamp examination was done. Keratometry readings were taken on the 6th month visit to assess post-operative astigmatism by comparing them with pre-operative keratometry readings.

Statistical Analysis

The data were collected and statistical analysis was done. The data were subjected to Chi square tests and the results were analysed.

Results

A total of 50 patients were studied of which 31(62%) were female and 19 (38%) were male. Majority of the patients included in this study fell in the age group between 50-60 (52%) years. 26 patients (52%) of the group were diagnosed with immature cataract.

Four patients from the group had Good corrected pre-operative vision (6/6-6/18). Majority of the patients (60%) had Poor pre-operative vision (<6/60), while 16 patients (32%) had Borderline pre-operative vision (6/18-6/60).

Pre-operative corneal astigmatism ranged from 1.75D ATR (Against The Rule) to 1.75D WTR (With The Rule). Four cases (8%) had no astigmatism to begin with and 21 cases (42%) had 0.25-1.00D ATR preoperative astigmatism.

Six months following surgery, the quality of vision improved in the group, with overall increase to 94% of cases with Good corrected vision and reduction in the Borderline and Poor vision categories.

Corneal astigmatism recorded in the post-operative period showed a general shift towards ATR astigmatism while two cases that had high WTR astigmatism remained as minimal WTR.

Astigmatism induced due to the surgical procedure was found to have a general shift towards ATR. However, nine (18%) cases from the group did not have any surgically induced astigmatism.

Table 1: Post-Operative Complications

| Post-Operative Complications | No. of Patients |
|----------------------------------|-----------------|
| Corneal burns | 33 |
| Corneal Oedema | 8 |
| Cortical Remnant | 6 |
| Cyclitic Membrane | 1 |
| Descement's Fold | 5 |
| Iritis | 6 |
| Lens Capture by pupil | 1 |
| Posterior Capsular Opacification | 9 |

| | |
|------------------------------|----|
| Uveitis | 3 |
| Vitreous in Anterior Chamber | 2 |
| Wound Gape | 3 |
| Striate Keratopathy | 25 |

Post operatively, corneal complications were by far the most numerous in the group. 33 cases had incisional burns or corneal burns, 8 had corneal edema (5 of whom had Descemet's folds) and 25 cases had striate keratopathy (Table 1).

Table 2: Cataract Type Versus Phaco Ultrasound Time

| Phaco Cataract Type | Phaco Ultra Sound Time | | | Total |
|--------------------------------|------------------------|-------------|--------|-------|
| | < 1:30 | 1:30 - 2:30 | > 2:30 | |
| Hyper Mature Cataract | 1 | 0 | 0 | 1 |
| Immature Cataract | 1 | 21 | 4 | 26 |
| Mature Cataract | 0 | 4 | 1 | 5 |
| Nuclear Sclerosis 2 | 0 | 1 | 1 | 2 |
| Nuclear Sclerosis 3 | 0 | 0 | 7 | 7 |
| Posterior Subcapsular cataract | 1 | 8 | 0 | 9 |
| Total | 3 | 34 | 13 | 50 |

Almost all types of cataracts could be managed within the stipulated Phaco-energy time of 2minutes 30seconds except for all Hard Nuclear Cataracts of grade 3 sclerosis. This was found to be highly significant ($p < .001$).

Table 3: Phaco Ultrasound Time Versus Incisional/Corneal Burns

| Phaco Ultra Sound Time | Incisional/Corneal Burns | | Total |
|------------------------|--------------------------|----|-------|
| | Yes | No | |
| < 1:30 | 0 | 3 | 3 |
| 1:30 - 2:30 | 20 | 14 | 34 |
| > 2:30 | 13 | 0 | 13 |
| Total | 33 | 17 | 50 |

Corneal burns were found on the 1st post-operative day in all cases where the Ultrasound time was in excess of 2minutes and 30seconds (13cases, 26%). These were also seen in cases in the 1:30-2:30 category as they neared the 2minutes 30seconds mark. There were no burns in the <1:30 category (Table 3). This part of the study was highly significant ($p = .001$).

Table 4: Incision Site Versus Surgery Induced Astigmatism

| Surgery induced Astigmatism | Incision Shape | No. of patients |
|-----------------------------|-----------------|-----------------|
| 2.00 ATR* | 1mm from Limbus | 2 |
| | 2mm from Limbus | 0 |
| | Total | 2 |
| 1.75 ATR* | 1mm from Limbus | 2 |
| | 2mm from Limbus | 0 |
| | Clear Cornea | 1 |
| | Total | 3 |
| 1.50 ATR* | 1mm from Limbus | 3 |
| | 2mm from Limbus | 0 |
| | Total | 3 |

| | | |
|-----------|-----------------|----|
| 1.25 ATR* | 1mm from Limbus | 2 |
| | 2mm from Limbus | 1 |
| | Total | 3 |
| 1.00 ATR* | 1mm from Limbus | 1 |
| | 2mm from Limbus | 0 |
| | Total | 1 |
| 0.75 ATR* | 1mm from Limbus | 2 |
| | 2mm from Limbus | 3 |
| | Total | 5 |
| 0.50 ATR* | 1mm from Limbus | 11 |
| | 2mm from Limbus | 0 |
| | Clear Cornea | 1 |
| | Total | 12 |
| 0.25 ATR* | 1mm from Limbus | 6 |
| | 2mm from Limbus | 3 |
| | Clear Cornea | 2 |
| | Total | 11 |
| None | 1mm from Limbus | 6 |
| | 2mm from Limbus | 2 |
| | Clear Cornea | 1 |
| | Total | 9 |

ATR* - Against the Rule

The group showed preponderance to a lesser degree of astigmatism with incisions closer to the limbus.

Table 5: Incision Shape Versus Surgery Induced Astigmatism

| Surgery induced Astigmatism | Incision shape | No. of Patients |
|------------------------------------|-----------------------|------------------------|
| 2.00 ATR* | Frown Incision | 1 |
| | Straight Incision | 1 |
| | Total | 2 |
| 1.75 ATR* | Frown Incision | 0 |
| | Straight Incision | 3 |
| | Total | 3 |
| 1.50 ATR* | Frown Incision | 0 |
| | Straight Incision | 3 |
| | Total | 3 |
| 1.25 ATR* | Frown Incision | 1 |
| | Straight Incision | 2 |
| | Total | 3 |
| 1.00 ATR* | Frown Incision | 1 |
| | Straight Incision | 0 |
| | Total | 1 |
| 0.75 ATR* | Frown Incision | 1 |
| | Straight Incision | 4 |
| | Total | 5 |

| | | |
|-----------|-------------------|----|
| 0.50 ATR* | Frown Incision | 5 |
| | Straight Incision | 7 |
| | Total | 12 |
| 0.25 ATR* | Frown Incision | 3 |
| | Straight Incision | 9 |
| | Total | 12 |
| None | Straight Incision | 9 |
| | Total | 9 |

ATR* - Against the Rule

The cases taken for this study showed an almost equal number of astigmatism with Frown and Straight incisions. However, a few cases with straight incisions did not have any surgically induced corneal astigmatism (Table 5).

Table 6: Incision Length Versus Surgery Induced Astigmatism

| Astigmatism | Incision Length | No. of Patients |
|----------------|-----------------|-----------------|
| 2.00 ATR* | 6mm | 2 |
| | Total | 2 |
| 1.75 ATR* | 6mm | 3 |
| | Total | 3 |
| 1.50 ATR* | 6mm | 3 |
| | Total | 3 |
| 1.25 ATR* | 6mm | 3 |
| | Total | 3 |
| 1.00 ATR* | 6mm | 1 |
| | Total | 1 |
| 0.75 ATR* | 6mm | 5 |
| | Total | 5 |
| 0.50 ATR* | 2.8mm | 1 |
| | 6mm | 11 |
| | Total | 12 |
| 0.25 ATR* | 2.8mm | 2 |
| | 6mm | 10 |
| | Total | 12 |
| No Astigmatism | 2.8mm | 1 |
| | 6mm | 8 |
| | Total | 9 |

ATR* - Against the Rule

Incisions of 2.8mm were generally least astigmatic than 6mm incisions.

Discussion

In our study of 50 cases, the age of the patients ranged from 50-60 years. There was a total of 31 female to 19 male patients. In a study by Popiela, *et al.*, to analyze the intra-operative and post-operative complications of phacoemulsification, the mean age was

69.4 years [4]. In a study on pseudophakic residual astigmatism by Bae *et al.*, the mean age of the patients at the time of surgery was 65.6 +/- 12.8. 40 patients were male and 49 eyes were the right eye [5].

Pre-operative vision

In our study group 60% of the patients had poor vision while 3.2% had borderline vision and the rest had good vision pre-operatively.

In a study by Robin, *et al.*, the median best corrected preoperative visual acuity of the patients was 20/80 [6].

Pre-operative astigmatism

Overall pre-operative corneal astigmatism ranged between 1.75D ATR to 1.75D WTR. Four cases had no astigmatism to begin with and 21 cases had 0.25D to 1.00D ATR pre-operative astigmatism.

In a study on pseudophakic residual astigmatism by Bae, *et al.*, the power of preoperative corneal astigmatism was predominantly less than 1.0 D, and 46 eyes were against-the-rule [5].

Incision

During surgery, incisions closer to the limbus were preferred. This was because a longer tunnel would cause difficulty in manoeuvring the phaco probe and increase the risk of complications. 36 cases (72%) were given incisions as close as 1mm away from the limbus. Nine cases were given incisions 2mm away from the limbus, 1 case at the limbus and 4 cases were clear corneal incisions.

Overall, 76% of the cases were given straight incisions and 24% cases were given frown incisions, as they are less astigmatic than the traditional curvilinear or smile incision since they lie within the Koch's incisional funnel.

Capsulotomy

Continuous curvilinear capsulorhexis was successfully done for all the cases. In a similar study by Martin and Burton, capsulorhexis failure was the commonest per-operative complication observed predominantly with denser cataracts [7].

Phacoemulsification Ultra Sound time

Attempts were made during surgery to limit the usage of phaco energy to a maximum of 2 minutes and 30 seconds. In 13 cases however the time had to be exceeded due to hard nuclei. In 3 cases, soft nuclei warranted the reduced usage of phaco energy. In majority of cases ultrasound time fell within the range of 1 minute 30 second and 2 minutes 30 seconds.

In a similar study by Robin *et al.*, the mean phacoemulsification Ultra Sound time was 2.2 +/-1.5 minutes [6].

Intra ocular lens

The common range of IOL power used was between +20.00D to +21.50D (42%). Rigid PMMA posterior chamber IOLs were generally preferred (90%), due to affordability. Foldable lenses were used together with small incisions for 4 cases. Anterior chamber IOL was used in 1 case with a large PC rent.

Yan and Mao in their study observed the safety and effect of suture less phacoemulsification with PMMA (Poly Methyl Meth Acrylate) intraocular lens, it was concluded that the procedure is safe even in hard cataracts [8].

Post-operative complications

i. Corneal Edema

In our study 8 patients had corneal edema post-operatively. In Wang, *et al.*, study the common postoperative complications were corneal edema in 89 eyes (4%), and corneal decompensation in 2 eyes (0.1%) [9]. Gavris, *et al.*, in their study had corneal edema in 34 cases (6.71%) intra-operatively [10]. In a study by Popiela, *et al.*, corneal edema was seen in 20% of cases [4]. Corneal edema is usually transient and disappears in 2 to 3 days. It can be treated with hypertonic saline eye drops.

ii. Post Operative Iritis

In our study 6 patients had iritis post-operatively. In a similar study by Gavris, *et al.*, Late inflammatory reactions were found in 6 cases (1.18%) post-operatively [10]. Post-operative iritis can be managed by frequent application of topical steroids, antibiotics, cycloplegics and nonsteroidal anti-inflammatory drugs.

iii. Posterior Capsular Opacification (PCO)

In our study 9 patients developed PCO post-operatively. Zheng and Liu study had PCO in 3% cases post-operatively [11]. Posterior capsular opacification can be managed by Nd:YAG capsulotomy which has complications of its own like damage to IOL, post-operative rise in Intra Ocular Pressure (IOP), cystoid macular edema and retinal detachment.

In our study, post-operatively corneal complications were by far the most numerous. 33 cases had incisional burns or corneal burns, 8 had corneal edema (5 of whom had Descemet's folds), and 25 cases with Striate keratopathy were detected.

Wang, *et al.*, analysed the causes of different complications of phacoemulsification cases. The common intra-operative complications were PCR in 70 eyes (3.1%), Iris damage in 16 eyes (0.7%), Iris prolapse in 6 eyes (0.3%), drop of lens fragments into vitreous in 3 eyes (0.1%) and tear of Descemet's membrane in 4 eyes (0.2%). The common post-operative complications were corneal endothelial edema in 89 eyes (4%), corneal decompensation in 2 eyes (0.1%), temporary intra ocular hypertension in 28 eyes (1.2%), pupillary dilatation in 7 eyes (0.3%), retinal detachment in 8 eyes (0.4%), cystoid macular edema in 24 eyes (1.1%) and displacement of intra ocular lens in 8 eyes (0.4%) [9].

Zheng and Liu investigated the reasons for and management of the complications in Phacoemulsification. Intra-operatively, there

was vitreous loss in 8.6% patients, iris chaffing in 5.6% patients, hyphema in 0.4% cases. Postoperatively, the complications were corneal oedema in 1.3% cases, primary PCO in 3.0% cases, inflammation in 0.9% patients and wound leak in 0.9% cases [11].

In another study by Gavris, *et al.*, to evaluate the intra and post-operative early complications of phacoemulsification technique, the early post-operative complications were corneal edema in 34 cases (6.71%); raised IOP in 18 cases (3.55%); retained lens material in 9 cases (1.78%); late inflammatory reactions in 6 cases (1.18%); hypopyon in 3 cases (0.59%); endophthalmitis in 3 cases (0.59%); retinal detachment in 1 case (0.2%) and anterior capsular fibrosis in 4 cases (0.79%) [10].

In a study by Popiela *et al.*, the intra-operative and post-operative complications of the first 50 cases of phacoemulsification were evaluated. Results showed posterior capsular rupture without vitreous loss in 4% cases and 10% cases with vitreous loss, Descemet's detachment in 4% cases, corneal oedema in 20% cases, transient intraocular pressure rise in 8%, hyphema in 2% and fibrin exudation in 2% cases [4].

In our study, astigmatism induced due to the surgical procedure was found to have a general shift towards ATR and 18% of cases did not have any surgery induced astigmatism.

In our study corneal burns were found on the 1st post-operative day in all the cases whereas the US time exceeded 2 minutes and 30 seconds in 13 cases (26%). These were also seen in cases in the 1:30 to 2:30 category as they neared the 2 minutes 30 seconds mark. There were no burns in the less than 1:30 category.

Post-operative visual acuity

On the 1st day following surgery the quality of vision improved in all the patients. There

was an increase in borderline corrected vision (78%) and a slump in the number of cases with poor vision (4%), while 9 patients (18%) had good vision on post-operative day 1.

After 6 months following surgery, the quality of vision had improved in all the patients, with an overall increase in cases with good corrected vision to 94% and reduction in the borderline and poor corrected vision categories.

In a study by Quillen and Phipps on visual outcomes and incidence of vitreous loss for residents performing phacoemulsification without prior planned ECCE experience. They found that post-operative BCVA was 20/40 or better in 97.7% of eyes, after excluding the cases with pre-existing ocular co-morbidities [12].

In a similar study by Yan and Mao the visual acuity of 0.5 (6/12) or better was obtained in 120 cases (95.2%) and that of 1.0 (6/6) or better was obtained 89 cases [8].

Post-operative astigmatism

Corneal astigmatism recorded in the post-operative period showed a general shift towards ATR astigmatism with 2 cases that had high WTR astigmatism remaining weakly WTR. Astigmatism due to the surgical procedure was found to have a general shift towards ATR. However 9 cases (18%) from the group did not have any surgically induced astigmatism.

Bae *et al.*, studied phacoemulsification cases with small incision to investigate pseudophakic residual astigmatism. According to their studies the mean post-operative corneal astigmatism was +0.29 D x 96°, mean post-operative refractive astigmatism was +0.20 D x 165° and mean pseudophakic astigmatism was +0.47 D x 176°. Axis distribution of pseudophakic astigmatism was predominantly Against The Rule (ATR). Power of pseudophakic residual

astigmatism was predominantly less than 1.0 D [5].

In our study the group showed preponderance to a lesser degree of astigmatism with incisions closer to the limbus. The cases showed an almost equal number of astigmatism with frown and straight incisions. Incisions of 2.8mm were generally least astigmatic.

Conclusion

Phacoemulsification with sutureless, self-sealing tunnel incisions has changed cataract surgery dramatically over the past two decades. This study showed that post-operative astigmatism and inflammation are typically minimal; visual recovery and patients' rehabilitation are accelerated with phacoemulsification. Though the procedure has its own set of complications, it is remarkably safe and the surgeon has to anticipate and try to prevent untoward complications rather than encountering and managing them.

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