

Constant Parameter Linear Phaco in Different Grades of Cataract: A Correlative Study of Visual Acuity with Phaco Time

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ABSTRACT

Purpose: To correlate first day postoperative LogMAR visual acuity with effective phaco time in phacoemulsification surgery with constant phaco parameter setting of linear mode in different grades of cataract.

Methods: One hundred forty-one consecutive senile cataract patients were enrolled in the study group. Phacoemulsification surgery in Linear mode with constant phaco parameters performed for grades I to V on exclusion of ocular comorbidities. Data recorded were age, sex, cataract grades as per The Lens Opacities Classification System III(LOCS), Effective Phaco Time (EPT), Total Phacoemulsification time (TPT), preoperative and first day postoperative uncorrected distant visual acuity in LogMAR standard.

Results: The mean preoperative visual acuity was >1 LogMAR in 51.77% cases and postoperative <0.5 LogMAR unit in 80% in all the grades of cataract. The Continuous mode Mean EPT both for trenching and sculpting were 38, 50.25, 63.48, 72.62 and 75.235 seconds in Grade I, II, III, IV, and V respectively. The TPT was 81.20, 98.45, 127.23, 149.49 and 163.27 seconds for grade I to V respectively. Improvement of Vision was statistically significant ($P < 0.001$) among all the grades of cataracts.

Conclusion: Constant phaco parameter setting in linear mode both for trenching and sculpting

for all the grades of cataract showed improvement of visual acuity. Higher the EPT less was the postoperative visual outcome. Higher the grades of cataract more were the EPT and TPT. EPT was more than other phaco modes in all the grades.

Keywords: Cataract grades, Phacoemulsification, Postoperative, Visual acuity

INTRODUCTION

Cataract is the major cause of blindness having a high prevalence rate in a higher age group and is reversible on timely surgical intervention. Phacoemulsification(PHACO) cataract surgery with Intraocular Lens implantation is the currently used technique for faster functional visual recovery with less intraoperative and postoperative complications than manual surgical procedure.^{1,2} There has been constant development of equipment and surgical techniques for quicker visual recovery, and systemic rehabilitation with fewer complications.³ PHACO cataract surgery carried out on Phaco needle excursion on Longitudinal, Transversal and Torsional Phacoemulsification machines. Ultrasound energy is delivered on continuous, pulse, burst, hyper pulse and hyper burst

modes.^{4,5,6} Longitudinal Phaco of continuous mode is the basic mode of phaco surgery. Trench Divide Conquer Nucleofractis (TDC) is the preferred technique by Phaco Surgeons of various phaco techniques.

Routine examination on the first postoperative day seen for inflammation, corneal edema, Tyndall effect, conjunctival hyperemia, BCVA, abnormal light scattering, patient reassurance and training of paramedical staff.^{7,8} BCVA (Best-corrected Visual Acuity) of 1.00 Diaptor Spherical equivalent is one of the target of Phaco surgery result. Another way of good outcome assessment is the percentage of eyes achieving Unaided Distant Visual Acuity (UDVA) $\geq 6/18$.⁹ The Royal College of Ophthalmologists, London, clinical guideline suggest the postoperative VA of less than 1.00 Diaptor in 85% cases and less than 0.5 Diaptor in 55% cases is the target.

PHACO cataract surgery conducted in linear mode with constant phaco parameters both for trenching and sculpting. This study aims to correlate the Effective Phaco Time (EPT) with different grades of cataract, First postoperative day Uncorrected Distance Visual Acuity (UDVA) with EPT and Preoperative and postoperative logMAR UDVA in different grades of cataract (Lens Opacities Classification System, LOCS III).¹⁰

METHODS

In the study period from January 2017 to March 2018, one hundred forty-one consecutive patients were selected randomly for phacoemulsification surgery in a secondary eye care centre. The study adhered to Helsinki Declaration and Hospital Ethics Committee. Informed consent, demographic data, risk-benefit of surgery were explained. Patients age more than 40 years with clear cornea, normal intraocular pressure, dilated pupil more than 6mm were included. Common ocular comorbidities like corneal pathology raised IOP, uveitis, complicated cataract, retinal pathology, previous ocular surgery were

excluded. The patient's data collected include age, sex, uncorrected distance visual acuity (UDVA). Patients were evaluated on slit-lamp microscopy, Indirect ophthalmoscopy, ultrasound A & B Scan. Standard formulas used for Intraocular lens power calculation. Visual acuity documented in the LogMAR unit preoperatively and on the first day postoperatively.

Lens opacity graded as per Lens Opacity Classification System III under the Slit Lamp examination. Nuclear hardness was graded by using a slit beam of low magnification oriented at 45 degrees to the visual axis of the patient. Slit height was little more than the pupil diameter, and the width was adjusted so the overall brightness of the slit image was good. Nuclear hardness was graded according to the color seen. If the cortex was hazy the brightness of the slit beam was increased to get penetrance into the lens substance. Cataract was graded I -V.

Surgical procedure included preoperative dilatation with Tropicamide 1% with Phenylephrine 2.5% eye drop and peribulbar anesthesia Xylocaine 2% with Bupivacaine. In all the phacoemulsification surgeries Carl Zeiss Model Visalis 100 (longitudinal Phaco system) Phaco machine was used by the 1st Author. Balanced salt solution used with bottle height kept at 110 cm above the eye level. Anterior chamber entered by 2.8 mm Keratome in two planar entry at 10.30 clock limbus in all the eyes. Anterior chamber filled with Healon viscoelastic. 5.5 to 6.0mm diameter Continuous curvilinear capsulorhexis by Utrata capsulorhexis forcep, Hydrodissection and Hydrodelineation were performed.

Phacoemulsifications carried out with 30⁰ tip in conventional Phaco techniques in continuous mode by divide and conquer method. Phaco parameters used were of power 50, Vacuum 60 and flow rate 25 and kept constant in trenching and fragment emulsification in all the cases irrespective of grades of nuclear hardness.

The common intra-operative complication was Iris prolapse. Foldable Monofocal acrylic IOL was used in all the cases. Effective phaco time and Total phaco time noted down from the control panel of the Carl Zeiss Model Visalis 100 Phaco machine. The anterior chamber was washed and the entry site sealed. Subconjunctival antibiotic with steroid given and patching done.

On the first postoperative day, Patients were examined for visual acuity (LogMAR chart), corneal status, anterior chamber depth and clarity, entry site, pupil size, and shape. Common complications observed were corneal edema, Descemet's folds. Postoperatively Antibiotic and steroid eye drops advised on 100 % patient follow up. All the data analyzed statistically using

Mean, Standard Deviation, Correlation Coefficient, paired t-test and p-value.

RESULTS

During the study period, 141 Phacoemulsification surgeries carried out within the age group of 40 to 70 years of Male 68(48.2%) and Female 73(51.2%), (Table -1). Cataracts were categorized to different grades of I to V (Table-2) as per the LOCS III classification system. Table- 3 shows Statistical analysis for different grades of Cataract.

Table 1- Age and Gender Distribution of Cataract Patient

Parameter	No. Of patients	Percentage (%)
Age 40-50	18	12.76
Age 51-60	57	40.42
Age 61-70	66	46.80
Total No. of Male	68	48.22
Total No. of Female	73	51.77

Table 2- Age wise grades of Cataract patients

Age-Group	Grade I	Grade II	Grade III	Grade IV	Grade V
40-50	1	3	7	2	5
51-60	7	8	13	12	17
61-70	0	9	30	15	12
Total-No. (%)	8(5.67)	20(15.18)	50(35.46)	29(20.56)	34(24.11)

Table 3 – Paired t Test of Significance

Mean EPT in seconds	Grades of Cataract	Mean Pre-op VA in Log MAR	Mean Post –op VA in Log MAR	T value	P value	Result
38	I	0.825	0.15	5.59	P<.001	Significant
50.25	II	1.175	0.305	7.11	P<.001	Significant
63.48	III	1.39	0.336	12.348	P<.001	Significant
72.62	IV	1.30	0.433	9.95	P<.001	Significant
75.235	V	1.53	0.468	11.42	P<.001	Significant

In grade I the mean EPT was 38 ± 13.34 seconds. The Mean of preoperative & postoperative visual acuity was 0.825 ± 0.423 & 0.15 ± 0.18 respectively. The correlation coefficient between EPT and Postoperative VA was 0.636 and the correlation coefficient between preop and postop VA was 0.619 indicate strong Positive correlation. The paired t-test was significant at a 95% confidence level with a p-value < 0.05%.

In grade II the correlation coefficient between EPT and postoperative visual acuity was 0.931 suggesting a strong positive correlation. Further, the correlation coefficient between pre and postoperative

VA was estimated to be -0.0503 indicating a -ve correlation. The mean EPT was 50.25 ± 20.057 seconds. The mean Pre-operative & postoperative VA was 1.175 ± 0.516 & 0.305 ± 0.157 respectively.

The paired t-test on Pre and Post-operative VA was significant under a 95% confidence level with P-value <.001.

In the grade III cataract, the correlation coefficient between EPT and Post-operative VA was 0.497 Indicating a +ve correlation. Further, the correlation coefficient between Pre and Post-operative VA was 0.307 indicating a Positive correlation. The mean EPT was 63.46 ± 22.71 seconds. The Mean preoperative &

postoperative VA was 1.39 ± 0.53 & 0.336 ± 0.255 respectively. The paired t-test under a 5% level was highly significant with P-value <0.001 . The t-test showed a significant difference between Pre and post-op VA.

In Grade IV cataract the correlation coefficient between EPT and post-operative VA was -0.0446 indicated a negative poor correlation. But the correlation coefficient between Pre and post-operative V.A. was 0.393 indicated a +ve correlation. The mean EPT was found to be 72.62 ± 31.68 seconds. The mean Pre-operative & postoperative VA was 1.30 ± 0.4495 & 0.433 ± 0.408 respectively. The paired t-test for significance between pre and post-operative VA was $t=9.95$ under a 5% level with a P-value <0.001 . It indicated a significant difference between the Preoperative and Postoperative VA.

In grade V cataract, the correlation coefficient between EPT and postoperative VA was 0.431 indicating a +ve correlation. Similarly, the correlation coefficient between pre and postoperative VA was 0.182 suggest a weak +ve correlation. The mean EPT was 75.235 ± 30.108 seconds. The mean Preoperative & postoperative VA in LogMAR was 1.53 ± 0.489 and 0.468 ± 0.347 respectively. A paired t-test applied to find out significance between Pre and Post-operative VA. The value under a 5% level of significance with P-value <0.001 indicated the test was highly significant at a 95% confidence level. This test implies that there is a significant difference between pre and postoperative VA.

Figure- 1 showed, the preoperative VA > 1 LogMAR in Grade I to V ; were 25%, 50%, 44%, 62% and 88% of cases respectively. The Post operative VA < 0.5 LogMAR were 100%, 90%, 84%, 75.885 and 70.56% of cases respectively . It shows a significant improvement of vision of 75% (100-25), 40%(90-50), 38%(82-44), 13.86% (75.86-62), 17.42%(88-58) in all the Grades.

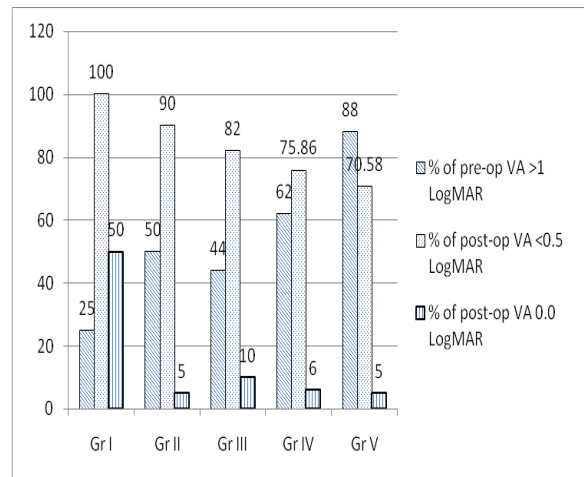


Fig 1 - Pre and postoperative percentage of visual acuity at different levels in LogMAR

DISCUSSION

The mean of Effective phaco time in continuous mode was less in lower Grades of cataract than higher and were 38.00, 50.25, 63.48, 72.62 and 75.235 seconds in Grade I, II, III, IV, and V cataract respectively (Table 3). YizhiLiu MD et al⁴ studied US time in conventional mode 10.25 ± 7.4 , 25.14 ± 5.5 , 36.45 ± 8.3 and 61.44 ± 17.8 seconds in grade 1,2,3,4 nuclear density respectively and in Torsional mode 8.32 ± 6.8 , 18.45 ± 7.2 , 29.48 ± 12.4 and 48.39 ± 20.3 in Grade 1 to 4 nuclear density respectively in Infiniti Vision System (Alcon Laboratories) Phacoemulsification machine. In another study by Panos G et al⁵ US time in longitudinal mode 110 ± 45 seconds, transversal mode 99 ± 40 and torsional mode 83.0 ± 33 in average grade 2 ± 0.8 cataracts in different machines. Ozkurt YB et al⁶ also studied the effective ultrasound time in burst, pulse, and linear modes to be 20.16 ± 16.57 , 39.95 ± 32.76 and 37.87 ± 22.89 respectively. Phacoemulsification surgery carried out in Carl Zeiss Visalis 100 Phaco machine in Continuous mode in linear setting of constant power for trenching and fragment emulsification in all the grades of cataract cases for trenching and fragments emulsification; thereby the phaco time (EPT and USTT) is more than other modes and techniques.

Visual outcome parameters are Visual Acuity, Quality of life and Economic

rehabilitation out of which visual acuity is a suitable parameter.¹¹ Postoperative visual outcome measured suitably by visual acuity gained is a common indicator to assess cataract surgery results.¹² In the present study preoperative VA was more than 1.0 LogMAR in 73 (51%) cases and 80% achieved UDVA 0.5 or better on 1st day follow up. Abdulsalam S et al¹⁵ studied good outcomes of VA 6/18 (0.5 LogMAR) or better in 48% in 1st postoperative day in 180 phaco cases. Visual outcome was assessed on the WHO standard and categorized as 6/6 – 6/18 (0.0-0.5 LogMAR) good outcome, 6/18 – 6/60 (0.5-1.0 LogMAR) borderline, <6/60 (1.0 LogMAR) poor.^{12,15} In our study 13 cases (9.2%) achieved postoperative visual acuity 0.0 LogMAR (20/20) and total visual recovery LogMAR 0.0(20/20) seen in 50% cases in Grade I Cataract.

Optimal visual acuity should be 0.3 as per the study by Norregaard et al.¹³ Liu J et al¹⁴ studied preoperative visual acuity had less than 0.1 in 53.5% cases and on 1st week postoperatively 0.5 or better in 44.8% cases in 116 patients.

In another study⁸ Postoperative uncorrected distant visual acuity increased by 0.38 (from 0.42 to 0.04) in 160 eyes in Cataract Surgery & Refractive Lens Exchange. In a study of 157 cases vision improved to 6/18 (0.5 LogMAR) or better in 85.4% cases on 1 month and 85.9% cases on 3 months follow up.¹⁵ In our study visual acuity increased in all the cases on 1st postoperative day which indicates a close relationship with the quality of life at par with this study. Standard IOL calculation formula used as per Axial length measurement i.e. Hoffer Q, Holladay, SRK T like other studies wherever applicable.^{16,17}

Phaco parameters used as ultrasound power 50, vacuum 60, flow rate 25 and bottle height 110cm which remain constant in all the grades of cataract both for trenching and sculpting. Neither of the above studies specifies the power modulations variations. EPT was higher in our study may be due to unchanged phaco

parameters for trenching and sculpting. Common Intraoperative complication observed was Iris prolapse and 1st-day Corneal behavior were Descemet folds, corneal edema and wound charring. Total ultrasound time (USTT) was 81.20, 98.45, 127.23, 149.49 and 163.27 seconds in grade I, II, III, IV, and V respectively. Bozkurt E, et al¹⁸ studied Mean USTT 1.6±1.1 minutes in 47 cases. Phaco time was higher in higher grades of cataract. The postoperative unaided distant visual acuity is higher in lower grades which consume less phaco time. In our study UDVA on 1st postoperative day was 80.0%.

CONCLUSION

In conclusion continuous mode effective phaco time (EPT) with constant phaco parameter for all the grades of cataract was studied. It is high in higher grades of Cataract. 1st postoperative day UDVA is significantly better in all the grades. Visual outcome (UDVA) is more in lower grades of cataract than higher grades on 1st post-op day. EPT and USTT is more than other phaco modes in all the grades of cataracts. UDVA in continuous Phaco mode is at par with other modes for different grades of cataract and within achievable target.

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Conflict of Interest – Nil.

REFERENCES

1. Chang-Godinich A, Ou RJ, Koch DD. Functional improvement after phacoemulsification cataract surgery. *J Cataract & Refract Surg.* 1999; 25(9): 1226-31
2. Chatziralli IP, Sergeantanis TN, Kanonidou E, Papazisis L. First postoperative day review after uneventful phacoemulsification cataract surgery: Is it necessary?. *BMC research notes.* 2012;5(1):333
3. Skiadaresi E, McAlinden C, Pesudovs K, Polizzi S, Khadka J, Ravalico G. Subjective quality of vision before and after cataract surgery. *Arch Ophthalmol.* 2012; 130(11): 1377-82

4. YizhiLiu MD, Mingbing Z, XialinLiu MD, ZhaohuiYuan MD, YuanlinXia MD, YangfeZeno MD. Torsional mode versus conventional ultrasound mode phacoemulsification: Randomized comparative clinical study. *J Cataract & Refract Surg.* 2007; 33(2):287-92
 5. Panos G, Christakis BSc, Rosa M, Braga-Mele MD. Intraoperative performance and postoperative outcome comparison of longitudinal, torsional and transversal phacoemulsification machines. *J Cataract & Refract Surg.* 2012; 38(2):234-4
 6. Ozkurt YB, Evciman T, Sengor T et al. Comparison of burst, pulse and linear modes used in phacoemulsification surgery. *Eur J Ophthalmol.* 2010; 20(2):353-64
 7. Tinley CG, Frost A, Hakin KN, McDermott W, Ewings P. Is visual outcome compromised when next day review is omitted after phacoemulsification surgery? A randomized control trial. *Br J Ophthalmol.* 2003; 87(11):1350-5
 8. Grob S, Talcott K, Thanos A, Chee Y. Review of Straylight before and after phacoemulsification in eyes with preoperative visual acuity better than 0-1 logMAR. *ASCRS EyeWorld* May 2014
Link address – Harvard Medical School ophthalmology residents. Massachusetts Eye & Ear Infirmary, Harvard Medical School, Hoston
 9. Vision 2020. The right to sight 2007. Global Initiative for the Elimination of Avoidable Blindness: Action plan 2006-2011. *World Health Organization. Geneva, 2007*
Link address – World Health Organization. Global Initiative for the Elimination of Avoidable Blindness: action plan 2006-2011, Geneva : World Health Organization. <http://www.who.int/iris/handle/10665/43754>
 10. Chylack LT Jr, Wolfe JK, Singer DM, et al. The Lens Opacities Classification System III. The Longitudinal Study of Cataract Study Group. *Arch Ophthalmol.* 1993; 111(6):831-6
 11. Lundström M, Brege KG, Florén I, Stenevi U, Thorburn W. Impaired visual function after cataract surgery assessed using the Catquest questionnaire. *J Cataract Refract Surg.* 2000 Jan 1;26(1):101-8
 12. Abdulsalam S. Comparison of visual outcome between conventional extracapsular cataract extraction and phacoemulsification cataract surgery. *Journal of Health Research and Reviews.* 2015; 2(3):99-102
 13. Norregaard JC, Bernth-Petersen P, Alonso J, et al. Variation in indications for cataract surgery in the United States, Denmark, Canada, and Spain: results from the International Cataract Surgery Outcomes Study. *Br J Ophthalmol.* 1998; 82(10):1107-11
 14. Liu J, Xu J, He M, Bao YK. The changes in quality of life in the patients after phacoemulsification with intraocular lens implantation. *Eye Science.* 2004; 20(3):135-9
 15. Oderinlo O, Hassan AO, Oluyadi FO, et al. Refractive aim and visual outcome after Phacoemulsification: A 2-year review from a Tertiary Private Eye Hospital in Sub-Saharan Africa. *Nigerian Journal of clinical practice.* 2017;20(2):147-52.
 16. Holladay JT. Proper method for calculating average visual acuity. *J Refractive Surgery.* 1997;13(4):388-91
 17. Sheard R. Optimising Biometry for best outcomes in Cataract Surgery. *Eye* 2014; 28(2):118-25
 18. Bozkurt E, Bayraktar S, Yazgan S, et al. Comparison of conventional and torsional mode (Ozil) phacoemulsification: randomized prospective clinical study. *European J Ophthalmol.* 2009; 19(6):984-9
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