Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

Original research article

A COMPARATIVE STUDY OF DIRECT-CHOP VERSUS STOP-AND–CHOP NUCLEOTOMY TECHNIQUES OF PHACOEMULSIFICATION

[1]Dr. Prashanth.B, [2]Dr Shwetha GR, [3]Dr. Sujata Sajjan

[1]Assistant Professor, Department of Ophthalmology, Basaveshwara Medical College and Hospital, Chitradurga, Karnataka

[2]Department of Ophthalmology, Mysore medical College and Research Institute, Mysore, Karnataka, India

[3]Consultant Ophthalmologist, Drishti Eye Hospital, Chitradurga, Karnataka, India

Corresponding Author:

Dr Shwetha GR

Abstract

Background: With the advent of phacoemulsification and other new techniques or innovations in it to give good postoperative results has been progressing steadily. Various methods of nuclear management in phacoemulsification like direct chop and stop and chop helps in reducing ultrasound energy, thereby decreasing surrounding tissue damage and early post-operative recovery. Among the both many surgeons have dissimilar opinions regarding the same, hence a sneak peek into comparison among both techniques is necessary.

Objectives: To study phaco parameters which include phaco power, vacuum, aspiration flow rate, effective phaco time in direct chop and stop-and-chop techniques, intra and post-operative complications and to assess post-operative visual acuity.

Methods: A prospective interventional study was carried out from December 2017 to June 2019 in which 150 patients who met inclusion and exclusion criteria underwent detailed examination and were divided into Group 1 and 2 equally to undergo phacoemulsification surgery by Direct chop and Stop and chop respectively with similar machine parameters. Intraoperatively EPT and complications noted. Postoperative follow up done. Visual acuity at 4 weeks was recorded.

Results: Mean age was 63.06 Y in Group 1 and 63.85 Y in Group 2. There were 22(29.3%) cases with PSC NS1 and 53(70.07%) cases with PSC NS2 in both groups. EPT was the main intraoperative parameter compared. Mean EPT was 2.55s in direct chop group and 2.59s in stop and chop group. Intraoperative and postoperative complications were similar in both groups (p-value 0.98). Of 75 patients in each group, 73(97.7%) in Group 1 and 72(96%) in Group 2 achieved BCVA of 6/6 – 6/9 at the end of 4 weeks.

Conclusion: The study showed that both the techniques of phacoemulsification showed equal productive response with regards to surgical duration and post-operative outcome.

Keyword: Phacoemulsification, direct chop, stop and chop, PSC NS1-2

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

Introduction

There are variety of cataract extraction methods which includes phacoemulsification (phaco), manual extracapsular cataract extraction (ECCE), and intracapsular cataract extraction. Initially intracapsular cataract extraction was the preferred method, today however it is used only in special situations. ECCE has replaced it and phacoemulsification is now the most frequently employed method in most of the developed countries. A survey showed that phacoemulsification is used in 86% and the manual ECCE in 14% of adult cataract extractions [1].

Phacoemulsification which was introduced by kelmann in 1967 changed the concept of cataract surgery to next level. Its principal advantage is the small incision size, which allows the surgeon greater control over intraocular structures during surgery. There is little tissue injury, less postoperative pain and inflammation, and less surgically induced astigmatism. As better machinery became available phacoemulsification in the posterior chamber or at the iris plane became more popular.

With popularisation of continuous curvilinear capsulorhexis techniques and its inherent advantages over the can-opener method, phacoemulsification techniques required major modifications. Because it becomes nearly impossible to safely prolapse the nucleus out of the capsular bag with this type of anterior capsulectomy, emulsification of nucleus must be performed inside the bag.

Many variations in phacoemulsification techniques have been described [2]. The aim of all techniques is to reduce stress on zonules, to mechanically break the nucleus into smaller fragments with the help of a second instrument thus minimising ultrasound energy and total ultrasound time used during emulsification of nucleus, protects intraocular tissues from surgical damage, minimise complication rate [3]. Phaco chop and stop and chop techniques are gaining popularity among ophthalmic surgeons [4]. The main difference between the two techniques is that in Stop and chop a central groove is created with use of ultrasound energy, this groove helps the surgeon to split the hard posterior plate facilitating the procedure.

Hence this prospective study is conducted in order to compare the results in these two nucleotomy techniques.

Methodology

Materials and methods

Source of data

Patients attending out-patient and in-patient department, department of ophthalmology, K R Hospital, Mysore, diagnosed with visually significant cataract who fulfil the inclusion and exclusion criteria during the study period.

Methods of collection of data

Study design: Prospective interventional study.

Study period: December 2017 to June 2019.

Sampling method: convenience sampling.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

Sample size: 150.

Total number of Phacoemulsification surgeries done in K.R. Hospital was 318 out of 3140 cases operated for cataract. This is based on previous year records. Based on prevalence of posterior subcapsular cataract with nuclear sclerosis as 0.17using Confidence Interval technique 5%, Absolute allowable Error - 7%, the inflated sample being 115. However during the data collection period, all the available cases considering, inclusion and exclusion criteria during the study period was taken for the study.

Inclusion criteria

Patients with posterior subcapsular cataract with nuclear sclerosis 1-2.

Exclusion Criteria

Patients with

1. Corneal opacity.
2. Pseudoexfoliation.
3. Rigid pupil.
4. Retinal pathology.

Method of study

All Patients included in study were evaluated in detail and were divided into two groups,Group 1 underwent phacoemulsification using the phaco-chop technique, Group 2 by stop-and-chop nucleotomy technique.

Intra-Operative

1) Phacoemulsification was performed by single surgeon after dilatation with tropicamide plus eye drops 0.8%.

2) Parameters used:

For trenching- Phaco 1- Maximum Power- linear continuous, 70%
Maximum vacuum- linear 40mmHg
Flow rate- 20cc/min

For chopping- Phaco 2- Maximum Power- linear pulse, 6pps, 50%
Maximum vacuum- panel 400mmHg
Flow rate- 32cc/min

For last nuclear piece and ENP removal-
Phaco 3- Maximum Power- linear pulse,6pps, 30%
Maximum vacuum- 180mmHg linear
Flow rate- 28cc/min

For cortex removal- IA 1- Maximum vacuum- 500mmHg linear
Flow rate- 32cc/min

For viscoelastic removal- IA 2- Maximum vacuum- 400mmHg
Flow rate- 50 cc/min

3) Group 1 patients underwent Direct chop/Phaco chop technique of nucleotomy by modified horizontal chopping. In Phaco 2, Phaco probe impaled into nucleus with use of power with footpedal in position 3, a good hold achieved in foot pedal position 2 by vacuum. the nucleus brought out of CCC margin and chopped into halves with chopper.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

The two halves again chopped into four pieces by rotating the halves so that the probe kept against the body of nucleus to get good vacuum seal. Later the pieces are emulsified and aspirated. Last nuclear piece removed in Phaco 3 to avoid surge related complications.

4)Group 2 patients underwent stop and chop technique of nucleotomy. Initially central trench is made in Phaco 1 until uniform red glow is seen. Nucleus cracked into two halves by using a chopper and a dialer. The halves rotated 90degree. In Phaco 2, chopping initiated by impaling the probe into body of nucleus in footpedal position 3, good vacuum hold achieved in position 2 and chopper introduced at the equator of endonucleus and brought towards the probe and multiple pieces made. Later the pieces are emulsified and aspirated. Last nuclear piece removed in Phaco 3 to avoid surge related complications.

5)ENP removal done in Phaco 3 by flip and chip technique. Cortical matter removed thoroughly by bimanual IA. Foldable IOL injected into the bag. Remaining viscoelastic removed by IA.

6) Anterior chamber formed, stromal hydration done. Subconjunctival injection of dexamethasone and gentamycin was given. Eye padded.

7)At the end of surgery, EPT, UST, AVG, any complications noted.

Post-operative

- Post-op follow up will be done on first postoperative day, third day, seventh day and 28^{th} day.
- Postoperative medication include a topical antibiotic eye drops and topical corticosteroid eye drops in tapering doses for a period of 4 weeks.
- Visual acuity evaluation will be done on 28^{th} day using Snellens chart.
- Additional treatment like systemic steroids, antibiotics, analgesics was advised whenever necessary.

Statistical Methods

Descriptive statistics

- The Descriptive procedure displays univariate summary statistics for several variables in a single table and calculates standardized values (z scores). Variables can be ordered by the size of their means (in ascending or descending order), alphabetically, or by the order in which the researcher specifies.
- Following descriptive statistics were employed in the present study-mean, Standard deviation, frequency and percent.

Chi-Square Test

The Chi-Square Test procedure tabulates a variable into categories and computes a chi-square statistic. This goodness-of-fit test compares the observed and expected frequencies in each category to test either that all categories contain the same proportion of values or that each category contains a user-specified proportion of values.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

Repeated Measure ANOVA

GLM Repeated Measures analyzes groups of related dependent variables that represent different measurements of the same attribute. This dialog box lets you define one or more within-subjects factors for use in GLM Repeated Measures. Note that the order in which you specify within-subjects factors is important. Each factor constitutes a level within the previous factor.

All the statistical methods were carried out through the SPSS for Windows (version 20.0)

Results

Mean age of patients in the study was 63.45 years. Out of 150 patients maximum were distributed among age group 61-70 years accounting for 104 (69.3%), followed by age group 51-60 years, 35 (23.3%) in number.

78 (52%) patients underwent surgery to right eye, and 72 (48%) underwent surgery to left eye.

In both the groups, there were 22 (29.3%) patients with PSC NS1 and 53 (70.7%) patients in PSC NS2.

Table 1: Pre-operative visual acuity

Pre-op BCVA	Group 1 (Phaco chop)	Group 2 (Stop and chop)	Total no. (percentage)
6/9	5	2	7 (4.6%)
6/12 – 6/18	28	20	48 (32%)
6/24 – 6/36	30	31	61 (40.6%)
6/60 – CF 5m	9	19	28 (18.6%)
CF 4m	3	3	6 (4%)
Total	75	75	150 (100%)

Patients had BCVA ranging from 6/9 to CF 4 m. BCVA was divided in five categories. 48(32%) of patients had BCVA between 6/12 - 6/18, and 61(40.6%) had between 6/24 – 6/36.

Table 2: Effective phacoemulsification time (EPT) comparison between the groups

EPT(seconds)	Group 1 (Phaco chop)	Group 2 (Stop and chop)	Total no. (percentage)
<1	5	5	10 (6.6%)
1-2	26	25	51 (34%)
2-3	29	23	52 (34.6%)
3-4	9	12	21 (14%)
4-5	3	5	8 (5.3%)
5-6	3	5	8 (5.3%)
Total	75	75	150

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

EPT varied between 0.3-5.8 seconds. On dividing into six categories; 26 (34.6%) and 29 (38.6%) patients who underwent Direct chop phaco had EPT 1-2 sec and 2-3 sec respectively. Whereas 25 (33.3%) and 23 (30.6%) patients who underwent Stop and chop phaco had EPT 1-2 sec and 2-3 sec respectively.

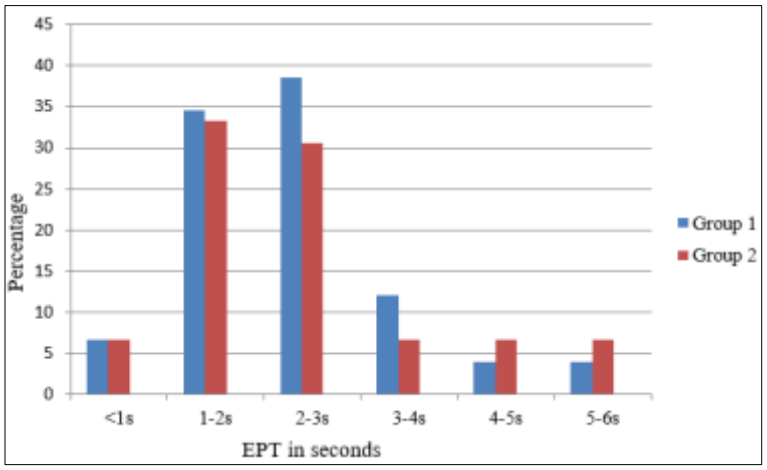

Fig 1: Effective phacoemulsification time comparison between the groups

Intraoperative complications were noted in 9 patients who underwent phaco chop technique out of 75. 3 patients had DM detachment, 2 patients with incomplete capsulorrhexis, 1 each with PCT, SICS convertion and tunnel related complication. The patient who had PCT while chopping was converted to SICS.

Intraoperative complications were noted in 10 patients who underwent stop and chop technique out of 75. 3 patients had DM detachment, 2 patients with PCT and iris incarceration into phaco probe. 1 each with incomplete rhexis, SICS conversion and tunnel related complication. One patient with PCT during trenching was converted to SICS.

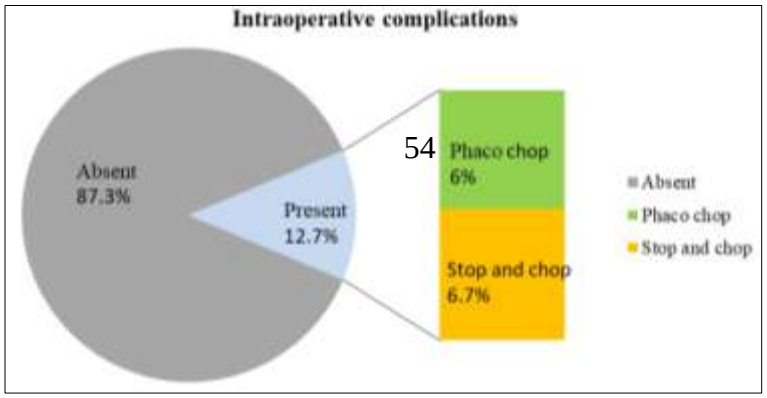

Fig 2: Intraoperative complications among patients

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

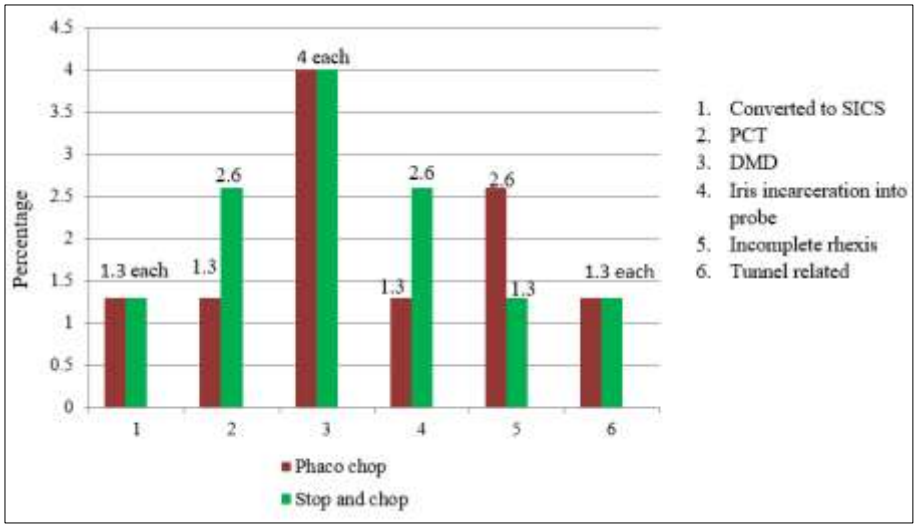

Fig 3: Comparing intraoperative complications in both groups

Table 3: Postoperative complication among patients

Postoperative complication	Group 1 (Phaco chop)	Group 2 (Stop and chop)	Total no
Absent	66	65	131
Present	9	10	19
Iritis	4	5	9
SK	4	4	8
IOL decentration	1	0	1
Iris prolapse	0	1	1
Total	75	75	150

Immediate postoperative complications noted were Iritis, striate keratopathy and IOL decentration and Iris prolapse. There were 4 patients and 5 patients in Group 1 and 2 respectively with Iritis, 4 patients each with striate keratopathy. 1 patient had IOL decentration in Group 1.1 patient in Group 2 with iris prolapse.

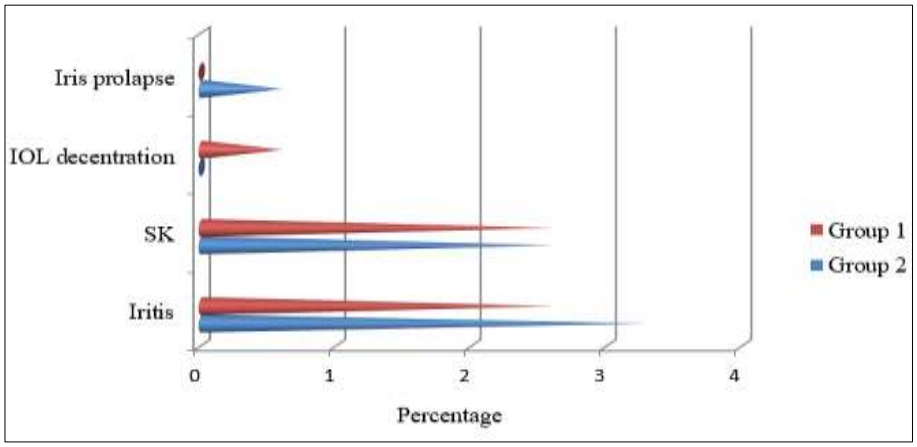

Fig 4: Postoperative complications among the Groups

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

Table 4: pre-operative and postoperative bcva at 4 weeks

BCVA at 4th week	Group 1 (Phaco chop)	Group 2 (Stop and chop)	Total no. (percentage)
6/6	68	65	133 (88.6%)
6/9	5	7	12 (8%)
6/12	2	3	5 (3.3%)
Total	75	75	150 (100%)

Postoperative BCVA at the end of 4 weeks was 6/6 in 133(88.6%) of patients with 68 patients in Group 1 and 65 patients in group 2. BCVA was 6/9 in 5 and 7 patients in Group 1 and Group 2 respectively. It was 6/12 in 2 patients and 3 patients in Group 1 and Group 2 respectively.

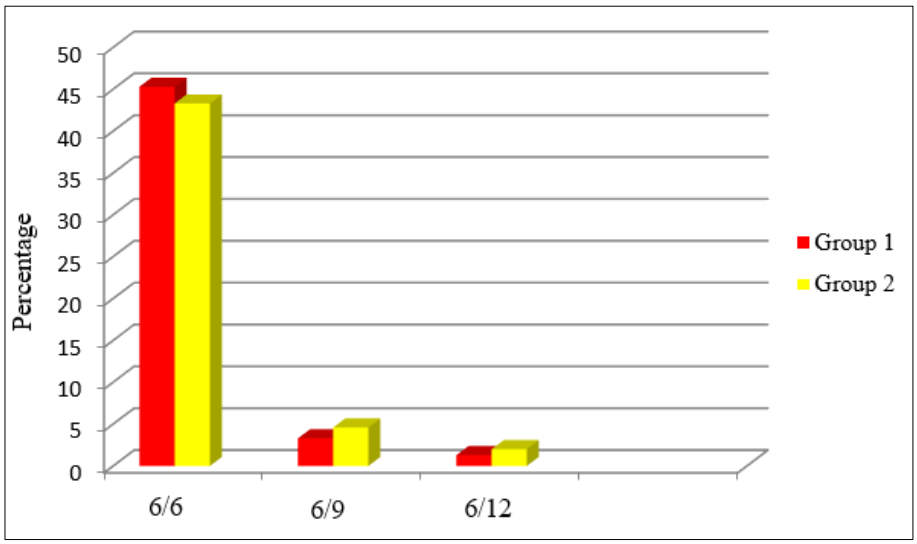

Fig 5: Postoperative BCVA at 4 weeks

Absence of intraoperative complications was associated with good postoperative BCVA at 4 weeks with 6/6.

Discussion

A prospective interventional study was conducted at KR Hospital, Mysuru to compare between Direct chop (Phaco chop) and Stop and chop nucleotomy technique (here onwards mentioned as Group 1 and Group 2 respectively) in Phacoemulsification surgery in patients with PSC NS2.

The study included 150 patients between age of 48-73 years. Mean age in the study was 63.06Y in Group 1 and 63.85Y in Group 2. Majority of subjects were in age group 61-70Y totalling 104(69.3%), followed by age group 51-60 Y accounting to 35(23.3%).

There were 79 (52.7%) males constituting the majority and 71(47.3%) females in the study.

78 (52%) patients underwent surgery in Right eye and 72(48%) in Left eye.

In both Group 1 and Group 2 there were 22(29.3%) cases each with PSC NS1 and 53 (70.07%) cases each with PSC NS2, out of 75 cases in each group.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

Pre-operative BCVA in this study ranged between 6/9 to CF 4 m. 116 (77.3%) patients had BCVA of 6/36 or better preoperatively.

Intraoperatively Effective Phacoemulsification Time (EPT) was the parameter compared between the two Groups. EPT ranged between 0.3s to 5.8s. Mean EPT in Group 1 was 2.55s and Group 2 was 2.59s. 55(73.2%) cases in Group 1, 48(63.9%) cases in Group 2 had EPT between 1-3 s. Rest of the subjects had EPT more than 3s. There was no statistically significant difference in EPT between the Groups showing P value - 0.82.

Park *et al*. study also showed similar results of mean EPT of 2.17s in Direct chop group and 3.86s in Stop and chop group, which were not statistically significant in moderate nuclear density. P value was 0.41 [3].

Study by Vajpayee *et al*. showed mean effective phaco time of 27s on Phaco chop cases and 28s in Stop and chop cases with no statistical significance between two groups [4].

Another study by Juwan Park *et al*. in Microincision Co-axial Phacoemulsification surgery also showed no statistical significance in mean EPT between Direct chop and Stop and chop group in NS2 nuclear grade cataract [5].

Intraoperative complications occurred in 19(12.7%) of cases out of 150. This is in concordance with the study conducted by K. Ravinder *et al*. where the intraoperative complication rate was 17% out of 100 subjects in their study. Intraoperative complications occurred in 12% in Group 1and 13.3% in Group 2.

PCT occurred in 1 case (1.3%) and 2 cases (2.6%) in Group 1 and 2 respectively. PCT in Group 1 occurred during cortical wash. In Group 2, one case had PCT which happened during trenching hence it was converted to SICS. MajMathur V *et al*. [6].

In his study had reported PCT during trenching. Another case in Group 2 had PCT during cortical wash. PCT cases were managed with anterior vitrectomy with sulcus fixated IOLs.

1 case (1.3%) in both the Groups had to be converted to SICS as nucleus was not completely emulsified. In Group 1 it was due to cheese wiring of the nucleus during chopping in PSC NS1. In Group 2 as mentioned earlier that case with PCT during trenching had to be converted to SICS.

Descemet's membrane detachment occurred in 3 subjects (4%) in both Group 1 and 2. Almost all these occurred near the main wound and side port, thus were peripheral away from pupillary region. However 1 case (1.3%) in Group 1 had DM detachment extending almost up to pupillary area. Probably it occurred due to blunt entry blade which extended on continued procedure of phacoemulsification. At the end of the procedure the detachment was managed placing a single large air bubble in anterior chamber.

Iris incarceration into Phaco probe in Group 1 was in 1 case (1.3%) and there were 2 (2.6%) in Group 2. In group 1 Iris incarceration into probe occurred during removal of epinuclear plate. In group 2 it occurred during trenching at the opposite pole of nucleus where accidently iris was caught hold. The foot switch was immediately moved to position 1 to release iris. Damage to iris was noted in all cases at the site of incarceration.

Incomplete capsulorhexis happened in 2 cases (2.6%) in Group 1, 1 (1.3%) in Group 2. In one such cases in Group 1 rhexis peripheral run off was noted which was completed from initial nick in opposite direction and phacoemulsification completed. In all other

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

cases rhexis was converted to can-opener capsulotomy. However the area converted to capsulotomy was small, Phacoemulsification could be performed safely.

Tunnel related complication occurred in 1 subject (1.3%) in each Group. This included one with unstable AC due to large main wound in Group 1 which resulted in surge. Another case in Group 2 also had iris prolapse intraoperatively through the large wound, which was reposited and wound sutured with 10-0 Nylon at the end of procedure.

Overall intraoperative complications between the two Groups was not statistically significant with P- value 0.98.

Postoperative complications on first postoperative day were present in 9 cases (6.6%) in Group 1 and 10 cases(6.6%) in Group 2. Iritis was noted in 4(2.6%) and 5(3.3%) in Group 1 and 2 respectively. Striate keratopathy in 4 subjects (2.6%) in each group. IOL decentration was seen in 1 case (0.6%) in Group 1. Post-operative iris prolapse was present in one case (0.6%) in Group 2.

Iritis was transient which resolved completely by one week post-operatively in most of the cases. One patient in Group 2 had persistent iritis for one month due to decreased compliance of topical medications by the patient. It resolved completely after few weeks of intensive topical steroid therapy.

SK was transient corneal edema in both the groups which resolved within one week postoperatively [7]. No statistical significance was found between two groups in Park *et al*. (P value- 0.80) where they compared with central corneal thickness measurements. Juwan *et al*. also had similar results in his study and found no statistical significance [8].

IOL decentration on first postoperative day was noticed in one case in Group 1 probably due to incomplete rhexis. M.J. Tappin *et al*. has also quoted early decentration of injected IOL in eyes without continuous curvilinear capsulorrhexis [9].

Iris prolapse through side port had in one case in Group 2 on first postoperative day. This patient had iris incarceration into phaco probe intraoperatively. The patient underwent iris reposition procedure on the first postoperative day and wound was sutured.

Post-operative BCVA at 4 weeks was noted. Most of the patients achieved BCVA of 6/6 – 6/9 totalling 145(96.6%); 73(97.7%) in Group 1 and 72(96%) in Group 2 out of 75 patients in each. 5 patients(3.3%) had BCVA of 6/12, 2 patients in Group 1 and 3 patienst in Group 2. Of patients having 6/12 BCVA, 2 subjects had PCT, one with IOL decentration and one patient had cystoid macular edema who was treated accordingly. Another patient had persistent iritis even at the end of 4weeks due to non-compliance of patient as mentioned earlier.

Park *et al*. [3] study had mean BCVA of 6/9 in both the groups with direct chop and Stop and chop nucleotomy. Other studies by Vajpayee *et al*., Juwan park *et al*., Can *et al*. [10], also showed no statistical significance in postoperative BCVA at the end of 4 weeks between the patients who underwent surgery by Direct chop and Stop and chop nucleotomy. However in Can *et al*. the healing period i.e. time to achieve BCVA was shorter in patients with Direct chop nucleotomy.

In cases who had intraoperative complications (19 in number), 15 cases (78.9%) had BCVA of 6/6-6/9. Cases with PCT had lesser outcome attaining 6/12.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

Conclusion

Phacoemulsification has evolved as standard of care since it was proposed by Charles Kelmen. Phacoemulsification has become the norm in most of the developed countries. Drift from manual small incisional cataract surgery to Phacoemulsification has become much stronger in India too among the surgeons.

With the introduction of capsulorhexis, phacoemulsification required a method to remove 8-10 mm nucleus through a 5-6 mm capsular opening. Gradually a variety of techniques to crack the nucleus were introduced. First approach is to disassemble the nucleus and then bringing the nuclear fractions into safe zone for emulsification became the foundation of all techniques used today.

Stop and chop technique as a modification of divide and conquer, is different from Direct chop in that a central groove is made using power then taking a pause for cracking nucleus followed by chopping and emulsification. Many times the groove is fundal glow dependent. In Direct chop power used only to impale the nucleus followed by chopping to create cleavage planes to disassemble the nucleus and is glow independent. Both these techniques can be used in nuclear grade 1-2 and are equally effective with similar machine parameter settings of aspiration flow rate, Vacuum and Power. Although in the study EPT in Stop and chop is slightly more than that in Direct chop, it was not statistically significant.

Intraoperative and postoperative complications were also comparable between the two techniques. Both the techniques had similar results on final visual outcome. Hence both the nucleotomy techniques are comparable; it is left to surgeon to decide which technique to use.

References

1. Jaffe NS, Jaffe MS, Jaffe GF. Surgical technique. Chapter 5. In: Cataratct surgery and its complications. 6th edition. St. Louis Mosby; c1997. p. 65.
2. Buratto L. Techniques of phacoemulsification. In BurattoL, ed, Phacoemulsification: Principlesand Techniques. Thorofare, NJ, Slack; c1998. p. 71-170.
3. Park JH. Ultrasound Energy in Phacoemulsification: A Comparative Analysis of Phaco-Chop and Stop-and-Chop Techniques According to the Degree of Nuclear Density. Ophthalmic Surg Lasers Imaging 2010;41:236-241.
4. Rasik B, Vajpayee. Phaco-chop versus stop-and-chop nucleotomy for phacoemulsification. J Cataract Refract Surg. 2000 Nov;26:1638-41.
5. Park J. Comparison of phaco-chop, divide-and-conquer, and stop-and-chop phaco techniques in microincision coaxial cataract surgery. J Cataract Refract Surg. July 2013;39(10):1-7.
6. MajMathur V, Col Singh VK. Phacoemulsification: Our experience at a large military hospital. MJAFI 2004;60(1):11-4.
7. Kausar A. Transient Corneal EdemaAfter Phacoemulsification. Journal of the College of Physicians and Surgeons Pakistan. 2015;25(7):505-509.
8. Park J. Comparison of phaco-chop, divide-and-conquer, and stop-and-chop phaco techniques in microincision coaxial cataract surgery. J Cataract Refract Surg. 2013 Jul;39(10):1-7.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

9. Tappin MJ, Larkin DFP. Factors leading to lens implant decentration and exchange. 2000;14:773-776.
10. Izzetcan. Comparison of Nagaharaphaco-chop and stop-and-chop phacoemulsification nucleotomy techniques. J Cataract Refract Surg. 2004 Mar;30:663-668.
11.