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Original Research Article

A Comparative Study of Direct-Chop versus Stop-And-Chop Techniques of Phacoemulsification

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ABSTRACT

Background: The most exciting innovation in cataract surgery in the 20 century is the technique of phacoemulsification, introduced by Kelman. Its principal advantage is the small incision size, less postoperative pain and less surgically induced astigmatism. Many variations in its techniques have been described. Among them stop-and-chop and phaco-chop are most popular. Hence the aim of this study is to compare the results in these two nucleotomy techniques.

Methods: A prospective interventional study was carried out for 1year.140 patients with PSC NS1-2 underwent detailed history and ocular examination. They were divided into 2 groups to undergo phacoemulsification surgery by direct chop and Stop and chop respectively with similar machine parameters. Intraoperatively EPT noted. Visual acuity at 4 weeks recorded.

Results: Mean age was 61.06 years in Group 1 and 63.85years in Group 2. There were 19(27.1%) cases with PSC NS1 and 51(72.8%) cases with PSC NS2 in both groups. Mean EPT was 2.55s and 2.59s respectively. Of 70 patients in each group, 68(97.1%) in Group 1 and 69(98.5%) in Group 2 achieved BCVA of 6/6-6/9 at the end of 4 weeks.

Conclusion: The study concluded that both the techniques are equally efficacious and comparable in cataracts with PSC NS1-2. The choice of technique should be based on cataract density, surgeon's expertise, and individual patient factors. Continued advancements in phacoemulsification technology will further refine surgical outcomes and improve patient safety.

Keywords: Phacoemulsification, Nucleotomy Technniques, Effective Phaco Time.

INTRODUCTION

Cataract remains the leading cause of reversible blindness worldwide and continues to impose a significant public health burden, particularly in developing countries.[1,2] The evolution of cataract surgery from intracapsular extraction to modern phacoemulsification has dramatically improved surgical safety, visual rehabilitation, and patient satisfaction.[3,4] Following the introduction of intraocular lens implantation by Ridley, phacoemulsification has become the gold standard for cataract extraction due to its small incision size, reduced surgically induced astigmatism, and rapid postoperative recovery.[5,6]

Successful phacoemulsification depends on multiple factors, including surgical anatomy,

lens–zonular integrity, machine technology, and, most importantly, the technique of nuclear disassembly.[7–9] Nuclear fragmentation plays a pivotal role in determining ultrasound energy usage, effective phacoemulsification time, and corneal endothelial preservation.[10] Excessive ultrasound energy has been shown to result in endothelial cell loss, postoperative corneal edema, and delayed visual recovery.[11,12]

Among the various nucleotomy techniques described, direct-chop and stop-and-chop techniques are widely employed. The direct-chop technique, originally described by Nagahara, involves immediate mechanical division of the nucleus without prior sculpting, resulting in reduced ultrasound energy delivery and shorter operative time. [10, 13] In contrast, the stop-and-chop technique combines an initial sculpting step with subsequent chopping of the nucleus, offering improved intraoperative control and a gentler learning curve, especially for surgeons transitioning from divide-and-conquer techniques. [14, 15]

Several comparative studies have evaluated direct-chop and stop-and-chop techniques with respect to ultrasound energy consumption, endothelial cell loss, and intraoperative efficiency, particularly across varying grades of nuclear density.[11,16–18] While both techniques yield excellent visual outcomes, differences in energy dynamics and corneal safety necessitate further comparative evaluation.

This study aims to compare direct-chop and stop-and-chop techniques of phacoemulsification with respect to intraoperative parameters and surgical outcomes, thereby guiding optimal technique selection in routine cataract surgery.

MATERIALS & METHODS

This prospective interventional study was conducted for a period of one year in Ophthalmology Outpatient Department of a tertiary care teaching institute situated in South Karnataka. The study was approved by the institutional ethical board and adhered to the declaration of Helsinki. All patients visiting the outpatient department with posterior subcapsular cataract with nuclear sclerosis 1-2 were included in the study during the period of 18 months from March 2024 to August 2025. Best-corrected visual acuity was assessed using Snellen's chart. Anterior segment examination and cataract grading (LOCS III) were performed with slit-lamp biomicroscopy. Intraocular pressure was measured by rebound tonometry, and fundus examination was done. Keratometry and A-scan biometry were used for IOL power calculation. Patients were divided into direct-chop and stop-and-chop phacoemulsification groups.

Sampling Method: convenience sampling

Sample Size: 150 (n = 51)

Inclusion Criteria

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

Exclusion Criteria

Patients with Corneal opacity, Pseudoexfoliation, Rigid pupil, Retinal pathology.

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 0.17 using 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.

Statistical Analysis

SPSS 2024 was used for statistical analysis of this study data. All quantitative/numerical data were analysed by using parametric tests whereas all qualitative data were analysed by using non-parametric tests to find the significance level. All data has been presented in tabular and graphical presentation and p-value <0.05 was considered as significant.

RESULTS

The study included patients with majority of subjects were in age group of 61-70years There were 79(52.7%) males constituting the majority and 71(47.3%) females in the study. Pre-operative BCVA in this study ranged between 6/9 to CF 4m [Table 1]

EPT ranged between 0.3 to 5.8s. Mean EPT in Phaco chop was 2.55s and in stop-and-chop was 2.59s which was statistically insignificant.

Intraoperative complications were noted in 4 patients of phaco chop technique. 2 patients had DM detachment, 1 had capsulorrhexis run off, 1 had posterior capsule tear which was during Irrigation and aspiration.

Among the patients who underwent stop-and-chop 5 had intraoperative complications.1 patient had posterior capsule tear, 1 had iris

incarceration, 2 had DM detachment and 1 patient had incomplete rhexis [Figure1].
Postoperative BCVA at the end of 4 weeks was 6/6 in 133(88.6%) patients with 68 patients in Phaco chop and 65 patients in stop-and-chop technique. BCVA was 6/9 in 5 and 7 patients in phaco chop and stop-and-chop respectively. It was 6/12 or lower in patients with intraoperative complications [table 2].

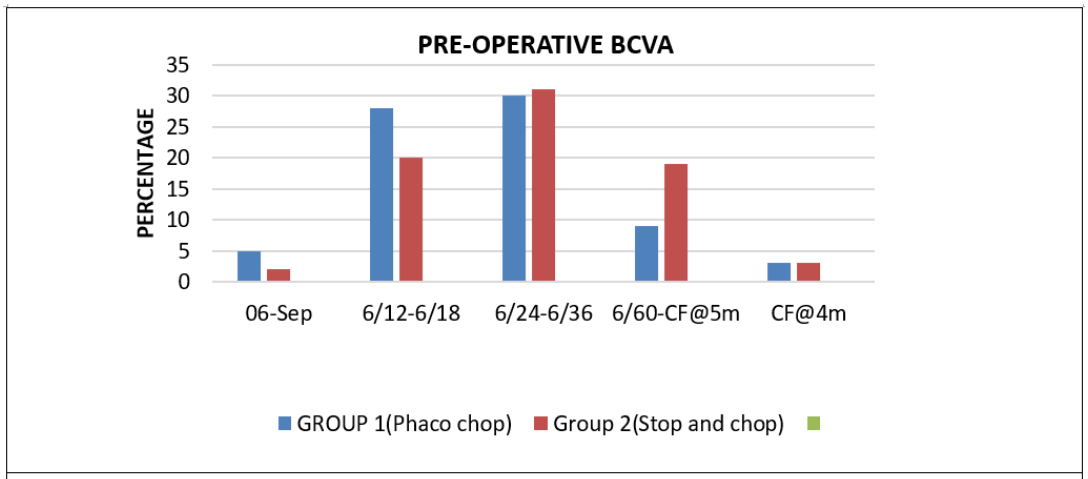

Table 1: Showing pre operative BCVA

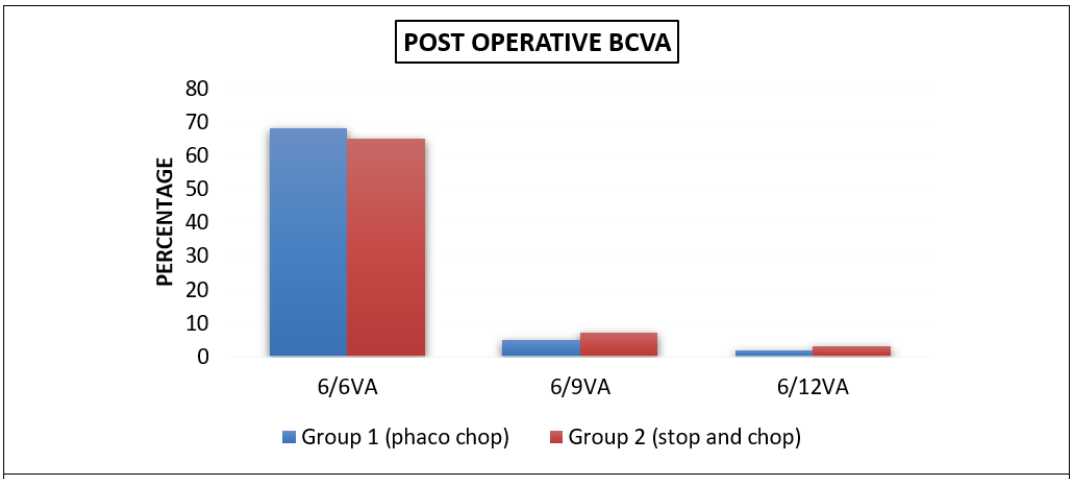

Table 2: Postoperative BCVA comparison between two groups

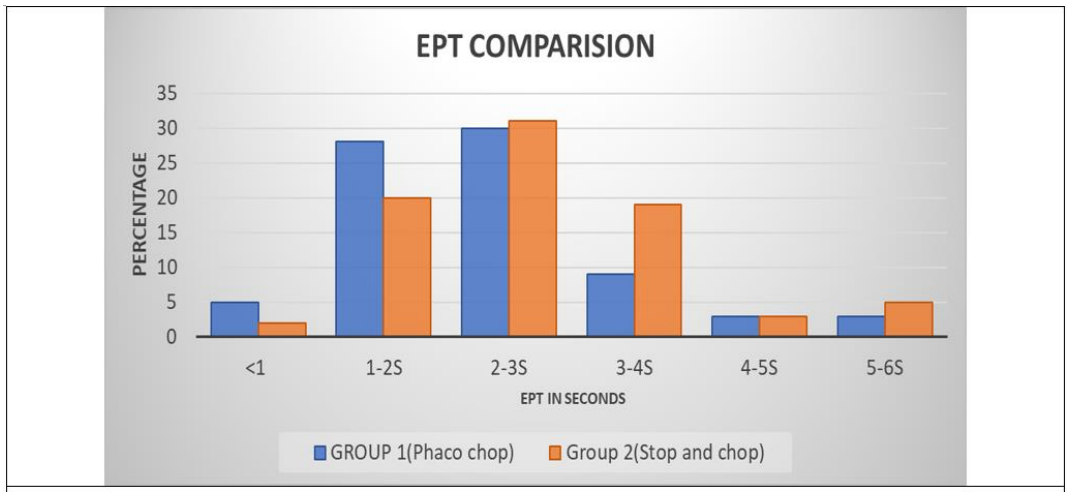

Table 3: Comparison of EPT between two groups

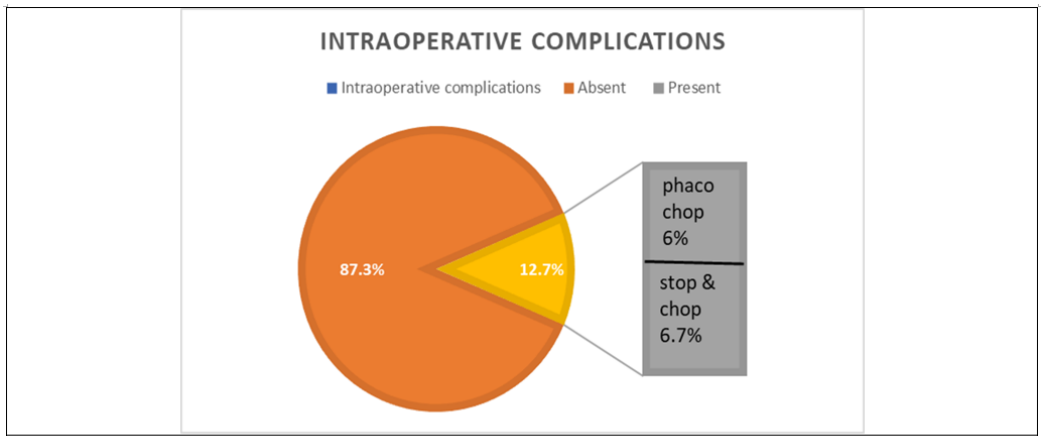

Figure 1: Intraoperative complications comparison between two groups

DISCUSSION

In this study, most subjects were aged 61–70 years, consistent with the typical demographic for senile cataract surgery, as nuclear sclerosis progresses with age.[19,20,11] Gender distribution showed a slight male predominance (52.7%), similar to previous reports, with no clinically significant impact on outcomes.[19,20]

Pre-operative BCVA ranged from 6/9 to counting fingers at 4 m. Both phaco-chop and stop-and-chop techniques provided significant postoperative visual improvement, with most patients achieving 6/6–6/9, aligning with prior studies. [20, 21, 22]

Effective Phaco Time (EPT) was comparable between groups (2.55 s vs 2.59 s; $p > 0.05$), consistent with literature showing similar energy usage between techniques.[19,20,11] Phaco-chop may trend toward slightly lower phaco time and energy, but this does not translate into significant differences in BCVA or endothelial outcomes.[19,20,21-23]

Corneal endothelial changes were minimal and comparable between techniques, although phaco-chop may produce less transient edema due to reduced manipulation.[19,11,21,23]

Complications such as posterior capsule rupture or zonular stress, rather than technique choice, were the main determinants of suboptimal visual outcomes.[19,20,11,22] Cases with intraoperative challenges achieved slightly lower postoperative BCVA (~6/12).

Overall, both phaco-chop and stop-and-chop are safe and effective for nuclear disassembly, producing comparable visual and intraoperative outcomes.

CONCLUSION

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.

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. In Direct chop power used only to impale the nucleus followed by chopping to create cleavage planes to disassemble the nucleus. 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.

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