# Phaco chop versus stop and chop nucleotomy techniques: A comparative evaluation

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## Abstract

To perform a comparative evaluation of phaco chop versus stop and chop nucleotomy techniques in phacoemulsification.

**Materials and Methods:** 60 patients with uncomplicated senile cataract were included in this study which were randomly divided into phaco chop group (group 1) and stop and chop group.
(group 2) with 30 patients each and each group had 10 patients each of nuclear sclerosis grade II, III and IV. The main parameters were effective phaco time, total balanced salt solution used, total phacoemulsification power, intraoperative complications and postoperative visual acuity on day 1, 1st week and 3rd week.

**Results:** The mean effective phacoemulsification time was 30.33±3.77 seconds in group 1 and 31.63 ± 4.22 seconds in group 2. The mean total phacoemulsification power in group 1 was 38.97 ± 4.33% whereas 41.93 ± 7.09 % in group 2. The mean total BSSV used in group 1 was 111.67 ± 13.86 ml whereas 113.17 ± 19.94 ml in group 2. The difference between the two groups was not significant. All patients received BCVA of 6/6 in both the groups after 3 weeks.

**Conclusion:** The stop and chop technique and phaco chop technique are equally efficacious for nuclear cracking in patients in terms of visual acuity but if we compare according to nuclear grading, stop and chop technique requires more phaco power, phaco time and balanced salt solution which can lead to higher endothelial cell loss in grade IV nuclear cataract.

**Keywords:** Cataract, Nucleotomy, Phacoemulsification, Phaco chop, Stop and Chop.

## Introduction

The main cause of curable blindness worldwide, is cataract with developing world accounting for approximately three fourth of blindness.[1,2] Cataract is held to be responsible for 50-80% of bilateral blindness in India. 100 million eyes are with vision of <6/60 due to cataract which is increasing due to population growth and increasing life expectancy.[3] There is evolution in cataract surgery over the years from couching in the ancient era to phacoemulsification of the present era. Earlier, intracapsular cataract extraction (ICCE) was the operation of choice, but by 1950, extra capsular cataract extraction (ECCE) was started with the placement of the artificial lens in the capsular bag. In 1967, phacoemulsification was introduced by Kelman which represented the beginning of a revolution in cataract surgery that made it possible to abandon more invasive procedures.[4] In particular, incision size has decreased from 10.0 mm in intracapsular cataract extraction to 7.0 mm in extra capsular cataract extraction and ultimately to the small incisions (3.2 to 2.8mm) used in phacoemulsification.[4,5] Phacoemulsification has some additional harm for corneal endothelial cells due to ultrasound energy used as compared with extracapsular cataract extraction.[6-9] This corneal endothelium damage can be due to many factors such as irrigation flow, turbulence and the movement of fluids, presence of air bubbles, direct trauma caused by instruments or lens fragments, and the phaco time and power needed to achieve nuclear emulsification.[10-17] Many methods have evolved in recent years to enhance the efficacy of nuclear management. The main purpose of these techniques is to mechanically break the nucleus into smaller fragments with the help of a chopper and decrease the use of ultrasound power in nuclear emulsification and also reduce surgical time to minimize endothelial damage.[9,12] The stop and chop and the phaco chop are two popular techniques.[18,19] The nucleus is divided mechanically into smaller fragments with the help of chopper in both the techniques. The main difference between the two is that at the beginning of stop and chop procedure, ultrasound energy is used to produce a central groove. The cavity, which is produced by using more ultrasound power, helps the surgeon split the hard posterior plate facilitating the procedure.[20-21] The corneal endothelial cell count after phacoemulsification is an indicator of surgery induced damage to the cornea. Other parameters are the energy dissipated and turbulence and movement of fluids in the anterior chamber.[22-23] Only a few studies have compared the two techniques. Therefore, the present study was done to compare phaco chop and stop and chop nucleotomy techniques in terms of the efficacy and safety of the two techniques prospectively.

## Materials and Methods

The prospective, randomized interventional study was conducted on 60 patients having uncomplicated senile cataract with NS grade II, III and IV attending the outpatient department of Ophthalmology, Hindu Rao Hospital, Delhi with proper informed consent. The patients were randomized into phaco chop group (group 1) and stop and chop group (group 2) with 30 patients each. In both the groups 10 patients each of NS grade II, III and IV were taken and were compared. Younger patients with age <50years, hypermature senile cataract, grade I nuclear sclerosis, complicated and traumatic cataract and patients having any other ocular and

systemic pathology were excluded from the study. Detailed history and examination was done. Preoperative assessment was done with IOL power calculation by SRK II formula. Phacoemulsification was done by a single surgeon by Oertli system. Intraoperative parameters like effective phaco time, total balanced salt solution used and ultrasound energy used were assessed for both the groups. All postoperative patients were given topical antibiotic steroid eye drops every 4 to 6 hourly for 4 weeks, topical tropicamide 1% eye drops twice a day for 2 weeks and topical lubricant eye drops four times a day for 4 weeks. All postoperative patients were regularly followed up and visual acuity was assessed by Snellen's chart on day 1, 1st week and 3rd week.

## Results

The mean effective phaco time in group 1 was 30.33 ± 3.77 seconds whereas in group 2 it was 31.63 ± 4.22 seconds. The p value was 0.214 which was not statistically significant. The mean total phaco power in group 1 was 38.97 ± 4.33% as compared to 41.93 ± 7.09% in group 2. The p value was 0.056 which was statistically not significant. The mean volume of BSS used in group 1 was 111.67 ± 13.86 ml and in group 2 it was 113.17 ± 19.94ml. The p value was 0.736 which is again statistically not significant. (Table 1)

The mean effective phaco time in group 1 was 26.00 ± 1.41 seconds whereas in group 2 it was 26.60 ± 1.08 seconds in patients with Nuclear Sclerosis Grade II. The p value for this was 0.300 which was not significant, statistically. In NS II the mean total phaco power in group 1 was 34.60±1.51% whereas in group 2 it was 35.30 ± 3.95%. The p value was 0.829 which was statistically not significant. For NS II the mean volume of BSS used in group 1 was 96.00 ± 5.16 ml whereas in group 2 it was 95.00 ± 7.07ml. With a non-significant p value of 0.722. (Table 2)

For patients with Nuclear Sclerosis grade III the mean effective phaco time in group 1 was 30.80±1.99 seconds whereas in group 2 it was 32.10 ± 1.37 seconds. The p value here was 0.106 which was again not statistically significant. The mean total phaco power in patients of group 1 was 38.10 ± 2.13% whereas in patients of group 2 it was 40.70 ± 4.52% in NS III. The p value was 0.117 which was statistically not significant. In patients of group 1, the mean volume of BSS was 112.50 ± 7.55 ml whereas in group 2 it was 106.00 ± 8.43ml in NS III. With a non-significant p value of 0.086. (Table 3)

In patients with Nuclear Sclerosis Grade IV the mean effective phaco time in group 1 was 34.20 ± 1.48 seconds whereas in group 2 it was 36.20 ± 1.69 seconds. This data was statistically significant with the p value of 0.011. The difference in mean total phaco power in group 1 was 44.20 ± 1.14% whereas in group 2 it was 49.80 ± 2.57% in NS IV ($p<0.001$) which was again statistically significant. In group 1, the mean volume of BSS used was 126.50 ± 4.12 ml as compared to group 2 where BSS used was 138.50 ± 4.74 ml in NS IV which was statistically significant ($p<0.001$). (Table 4)

**Table 1: Comparison of EPT (in seconds), TPP (in%) and BSSV (in ml) used in both the groups irrespective of NS Grade**

| | Group 1 | | Group 2 | | P Value |
|---|---|---|---|---|---|
| | **Mean** ± SD | **Min – Max** | **Mean** ± SD | **Min – Max** | |
| EPT | 30.33 ± 3.77 | 24-36 | 31.63 ± 4.22 | 25-37 | 0.214 |
| TPP | 38.97 ± 4.33 | 30-46 | 41.93±7.09 | 26-54 | 0.056 |
| BSSV | 111.67 ±13.86 | 90-130 | 113.17 ±19.94 | 90-145 | 0.736 |

**Table 2: Comparison of EPT (in seconds), TPP (in%) and BSSV (in ml) in NS II in both the groups**

| | SLE = NSII | | | | |
|---|---|---|---|---|---|
| | Group 1 (n=10) | | Group 2(n=10) | | P Value |
| | **Mean** ± SD | **Min – Max** | **Mean** ± SD | **Min – Max** | |
| EPT | 26.00 ± 1.41 | 25-29 | 26.60 ± 1.08 | 25-28 | 0.300 |
| TPP | 34.60 ± 1.51 | 33-37 | 35.30 ± 3.95 | 26-40 | 0.607 |
| BSSV | 96.00 ± 5.16 | 90-105 | 95.00 ± 7.07 | 90-110 | 0.722 |

**Table 3: Comparison of EPT (in seconds), TPP (in%) and BSSV (in ml) in NS III in both the groups**

| | SLE = NSIII | | | | |
|---|---|---|---|---|---|
| | Group 1 (n=10) | | Group 2(n=10) | | P Value |
| | **Mean** ± SD | **Min – Max** | **Mean ± SD** | **Min – Max** | |
| EPT | 30.80 ± 1.99 | 27-34 | 32.10 ± 1.37 | 30-34 | 0.106 |
| TPP | 38.10 ± 2.13 | 35-42 | 40.70 ± 4.52 | 30-45 | 0.117 |
| BSSV | 112.50 ± 7.55 | 100-120 | 106.00 ± 8.43 | 90-120 | 0.086 |

**Table 4: Comparison of EPT (in seconds), TPP (in%) and BSSV (in ml) in NS IV in both the groups**

| | SLE = NSIV | | | | |
|---|---|---|---|---|---|
| | Group 1 (n=10) | | Group 2(n=10) | | P Value |
| | Mean ± SD | Min – Max | Mean ± SD | Min – Max | |
| EPT | 34.20 ± 1.48 | 32-36 | 36.20 ± 1.69 | 33-38 | 0.011 |
| TPP | 44.20 ± 1.14 | 42-46 | 49.80 ± 2.57 | 46-54 | <0.001 |
| BSSV | 126.50 ± 4.12 | 120-130 | 138.50 ± 4.74 | 130-145 | <0.001 |

**Table 5: Postoperative best corrected visual acuity (BCVA) at first day postoperatively**

| Vision | | | Group 1 (n=30) | | | Group 2(n=30) | | | P Value |
|---|---|---|---|---|---|---|---|---|---|
| | | | Frequency | | % | Frequency | | % | |
| Ist Day | 6/12-6/18 | | 1 | | 3.3% | 1 | | 3.3% | 1000 |
| | 6/6-6/9 | 6/9 | 7 | 29 | 96.7% | 9 | 29 | 96.7% | |
| | | 6/6 | 22 | | | 20 | | | |

**Table 6: Postoperative best corrected visual acuity (BCVA) at 1st and 3rd week postoperatively**

| Vision | | Group 1 (n=30) | | Group 2(n=30) | | P Value |
|---|---|---|---|---|---|---|
| | | Frequency | % | Frequency | % | |
| 1st week | 6/6-6/9 | 30 | 100.0% | 30 | 100.0% | - |
| 3rd week | 6/6-6/9 | 30 | 100.0% | 30 | 100.0% | - |

## Discussion

The transition from Intracapsular Cataract Extraction (ICCE) to Extracapsular Cataract Extraction (ECCE) to phacoemulsification has really been a major breakthrough in cataract extraction. Phacoemulsification is the worldwide standard for cataract surgery. Preventing corneal endothelial cell damage during phacoemulsification surgery is crucial. The use of ultrasonic energy during nuclear emulsification is invariably associated with endothelial cell loss. Nuclear chopping techniques were introduced to further decrease endothelial cell damage.[23] These chopping techniques mechanically fragment the nucleus into smaller pieces and decrease the need for ultrasonic power to emulsify the nucleus. They also decrease the effective phaco and total surgical time, limiting the insult to the corneal endothelium. Various studies have been done to compare the safety and efficacy of various nucleotomy techniques. In our study we found that EPT, TPP and volume of BSS used was lower in phaco chop technique as compared to stop and chop technique which was not significant statistically but if we compared the two techniques according to nuclear density, then, in patients with NS II and NS III, the difference in mean effective phaco time, mean total phaco power and mean volume of BSS used in group 1 and group 2 was statistically not significant. Whereas in patients with NS IV, the difference in mean effective phaco time, mean total phaco power and mean volume of BSS used was statistically significant with p=0.011, p<0.001 and p<0.001 respectively.

No early intraoperative or postoperative complication occurred that require a change in therapy. In the phaco chop group 100% achieved a BCVA of 6/6 at 3 weeks and similarly 100% had achieved BCVA of 6/6 in the stop and chop group. (Table 5,6)

## Conclusion

The phaco chop technique is technically more difficult and has a longer learning curve. The stop and chop technique and phaco chop technique are equally efficacious for nuclear cracking in grade II and III but stop and chop technique requires more phaco power, phaco time and balanced salt solution which can lead to higher endothelial cell loss in grade IV nuclear cataract. Both the techniques are equally efficacious in terms of postoperative BCVA except for the fact that stop and chop technique prolong the healing of endothelial cells due to use of more phaco power. But it is easier to execute for most phaco surgeons. It is left to the surgeon to decide which technique to use.

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