

Original Article

# Corneal Clarity after Phacoemulsification: Nuclear Management by Stop and Chop vs Divide and Conquer Methods

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## Abstract

**Background:** Restoration of effective vision is the principal aim of all modalities of cataract surgery including Phacoemulsification. Energy level of ultrasonic power in Phacoemulsification and turbulence of fluid in the anterior chamber plays an important role in corneal endothelial cell loss influencing post-operative corneal clarity.

**Objectives:** To compare post-operative corneal clarity after Phacoemulsification by two techniques of nuclear divisions: stop and chop with divide and conquer. **Methodology:** This prospective observational study was conducted on Ophthalmology Department at Shaheed Monsur Ali Medical College and Hospital, Uttara, Dhaka from January, 2023 to June, 2023. The study was carried out on 30 outdoor patients undergoing Phacoemulsification at SMAMCH and Mirpur Eye Hospital, Dhaka. The selected patients underwent detailed ocular and systemic examinations with relevant investigations and divided equally into two groups comprising of 15 in group A (stop and chop) and 15 in group B (divide and conquer). Phacoemulsification was done in all patients by a single expert surgeon. Patients were followed up after 1 week, 4 weeks and 12 weeks of surgery. Corneal endothelial cell count and central corneal thickness were assessed in each visit. Mean value of these mentioned parameters in follow-up periods were compared between two groups. Unpaired t test was done to assess the level of significance. **Results:** The mean age  $\pm$  standard deviation (SD) of the study subjects was  $61.5 \pm 2$  years, out of which 13(43.33%) were males and other 17(56.67%) females. Pre-operative value of mean endothelial cell count was  $2620 \pm 70.20/\text{mm}^2$  in group A and  $2625 \pm 71.10/\text{mm}^2$  in group B. Postoperative mean value  $\pm$  SD of endothelial cell count was  $2420 \pm 68.90/\text{mm}^2$ ,  $2345 \pm 66.64/\text{mm}^2$ ,  $2310 \pm 66.04/\text{mm}^2$  respectively after 1 week, 4 weeks and 12 weeks of surgery in group A and  $2410 \pm 69.54/\text{mm}^2$ ,  $2340 \pm 65.87/\text{mm}^2$ ,  $2310 \pm 64.45/\text{mm}^2$  in group B respectively. Mean value  $\pm$  SD of central corneal thickness was  $545 \pm 40.50$  micrometer,  $535 \pm 40.02$  micrometer and  $532 \pm 39.85$  micrometer respectively after 1 week, 4 weeks and 12 weeks after surgery in group A and  $547 \pm 43.98$  micrometer,  $537 \pm 41.23$  micrometer and  $533 \pm 40.63$  micrometer respectively in group B. **Conclusion:** Quantitative assessment and comparison of endothelial cell count and central corneal thickness shows that at end of the study, there was no remarkable difference in mean values of endothelial cell count and central corneal thickness between two methods.

**Key Words:** Phacoemulsification, Corneal clarity, Divide and Conquer, Stop and Chop

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## **Introduction:**

There are various methods of cataract surgery- of them, phacoemulsification is considered as the 'gold standard' of all modalities of cataract surgery.<sup>1,2</sup>

The Phacoemulsification technique was initially described by Kelman in 1967.<sup>3</sup> In phacoemulsification, nucleus is ultrasonically divided and aspirated through an incision which is less than 3 mm in diameter.<sup>4,5</sup> Its acceptance is increasing day-by-day. It was found as a procedure of choice for about 50% of surgeons by 1999, 79% of surgeons by 1992 and is almost universal now-a-days.<sup>6</sup> All modern phaco methods depend on the principle of lens "disassembly" where hard nucleus is fragmented into gradually smaller maneuverable pieces.<sup>7,8</sup>

Many procedures have been described for the management of lens nucleus. They are of 2 broad categories. The first category are the sculpting techniques, including divide and conquer, in which phacoemulsification is done by sculpting the nucleus in order to decrease its size and to create trenches along which nucleus may be divided. The pieces of divided nucleus are then made into small pieces and emulsified.<sup>9</sup> In the other chopping techniques, a chopper, i.e., 2<sup>nd</sup> instrument is introduced and drawn across the nucleus to make the nucleus into smaller fragments. These smaller fragments can be separated by main mass of the nucleus and emulsified.<sup>10,11</sup> Considering the inherent disadvantages of packing of the chopped pieces like jig saw puzzle, especially in chopping techniques, Dr. Paul Koch developed the stop and chop technique. In this technique, Dr. Koch divided the nucleus by sculpting into two halves so that a space is created to facilitate the chopping process and removal of the nuclear pieces.<sup>12</sup> We conducted the current study in 2 groups of patients subjecting them to nuclear managements by stop and chop and divide and conquer techniques to compare the rate of corneal endothelial cell loss and central corneal thickness.

## **Methodology:**

This prospective observational study was conducted at Shaheed Mansur Ali Medical College and Hospital (SMAMCH), Uttara, Dhaka from January, 2023 to June, 2023. The study was carried out on 30 outdoor patients, undergoing Phacoemulsification at SMAMCH and Mirpur Eye Hospital, Mirpur, Dhaka on corneal endothelial cell loss and central corneal thickness.

Patients were selected based on some inclusion criteria like

nuclear grades 1-3, healthy cornea, full pupil dilatation, good red reflex, easy surgical access, average axial length (22-25mm), lack of other ocular comorbidities. Brown and black cataract, preoperative endothelial count less than 1,000 per sq.mm were excluded from this study. These 30 patients were randomly divided into 2 groups, who were operated by either of the two methods of nuclear division. In group A, 15 patients were operated by stop and chop technique and the other 15 by divide and conquer method in group B. After getting written informed consent, each of the patients in two groups underwent Phacoemulsification by one of these 2 techniques under peribulbar anaesthesia.

With divide and conquer technique, a deep groove was cut across the middle of the lens nucleus towards the opposite side of the capsulorhexis. Then by rotating the nucleus through 90°, the 2<sup>nd</sup> groove was created and followed by further rotation and sculpting to create a cross. The second instrument and phacoprobe were positioned into the grooves, and then nucleus was cracked into 4 quadrants.

In stop and chop technique,<sup>13</sup> a central trench was first sculpted and the nucleus was divided into 2 halves or 2 hemi nuclei, followed by stopping sculpting and commencing chopping. The nucleus was then divided into several pieces, which were aspirated conventionally.

All patients were followed up post-operatively after 1 week, 4 weeks and 12 weeks. Each patient underwent preoperative evaluation including best corrected visual acuity (BCVA) with Snellen's chart, detailed slit lamp examination, nuclear sclerosis grading, fundoscopy, intraocular pressure (IOP) by Goldman applanation tonometry (GAT) and regurgitation test to check the patency of nasolacrimal duct. Using TOPCON SP 3000P specular microscope, specular microscopy was done pre-operatively in each patient and corneal endothelial cell count and corneal thickness for each of the patients were determined and recorded.

## **Results:**

The mean age  $\pm$  standard deviation (SD) of the patients was 61 $\pm$ 2 years. The mean endothelial cell counts  $\pm$  SD were 2620  $\pm$ 70.20/mm<sup>2</sup> and 2625  $\pm$ 71.10/mm<sup>2</sup> preoperatively in group A and group B respectively. The counts were decreased to 2420 $\pm$ 68.90/mm<sup>2</sup> and 2410  $\pm$ 69.54/mm<sup>2</sup> in

1st post-operative visit after 1 week in group A and group B respectively, followed by further decreases to  $2345 \pm 66.64/\text{mm}^2$  and  $2340 \pm 65.87/\text{mm}^2$  in 2<sup>nd</sup> post-operative visits after 4 weeks, and  $2310 \pm 66.04/\text{mm}^2$  and  $2310 \pm 64.45/\text{mm}^2$  in 3<sup>rd</sup> post-operative visits after 12 weeks in group A and group B respectively. (Table I)

**Table I: Comparison of mean endothelial cell counts**

Groups	Mean endothelial cell count + standard deviation at different patient visits			
	(% loss from previous visit)			
	1 <sup>st</sup> Visit (Preoperative)	2 <sup>nd</sup> Visit (after 1 week post operatively)	3 <sup>rd</sup> Visit (after 4 weeks post operatively)	4 <sup>th</sup> Visit (after 12 weeks post operatively)
Group A	2620 ± 70.20 / mm <sup>2</sup>	2420 ± 68.90/ sq. mm (7.63% loss)	2345 ± 66.64/ sq. mm (3.09% loss)	2310 ± 66.04/sq. mm (1.49%)
Group B	2625 ± 71.10 /mm <sup>2</sup>	2410 ± 69.54/sq. mm (8.19% loss)	2340 ± 65.87/sq. mm (2.90%)	2310 ± 64.45/sq. mm (1.28%)

The mean + SD of corneal thickness of the cases in group A and group B was  $530 \pm 40.90$  micrometer and  $532 \pm 30.56$  micrometer respectively. The mean corneal thickness of the cases on follows up post-operatively after 1 week, 4 weeks and 12 weeks were found  $545 \pm 40.50$ ,  $535 \pm 40.02$  and  $532 \pm 39.85$  micrometer in group A and  $547 \pm 41.23$  and  $533 \pm 40.63$  micrometer in group B respectively. (Table II)

**Table II: Corneal pachymetry of the cases**

Groups	Mean value ± standard deviation of corneal thickness			
	Preoperative	Post-operative follow ups after-		
		1 week	4 weeks	12 weeks
Group A (n=15)	530 ± 40.90 μm	545 ± 40.50 μm	535 ± 40.02 μm	532 ± 39.85 μm
Group B (n=15)	532 ± 30.56 μm	547 ± 43.98 μm	537 ± 41.23 μm	533 ± 40.63 μm

Preoperative visual acuity of the majority patients in both group A was 6/24 or worse [12/15 (80.00%) and all of the patients in group B was 6/24 (15/15, 100.00%) in group B]. (Table III)

**Table III: Preoperative visual status of the patients**

Visual Acuity	Number (%) of patients	
	Group A (n=15)	Group B (n=15)
>6/18	0 (0.00%)	0 (0.00%)
6/24	2 (13.33%)	2 (13.33%)
6/36	3 (20.00%)	3 (20%)
6/60	4 (26.67%)	3 (20%)
5/60	3 (20.00%)	1 (6.67%)
4/60	1 (6.67%)	2 (13.33%)
3/60	1 (6.67%)	2 (13.33%)
2/60	0 (0.00%)	2 (13.33%)
1/60	1 (6.67%)	0 (0.00%)
<1/60	0 (0.00%)	0 (0.00%)

The majority of cases in both groups with best corrected visual acuity after 12<sup>th</sup> postoperative week was 6/12 or better [12(80.00%0 in group A and 13/15 (86.67%) in group B]. (Table IV)

**Table IV: Best Corrected Visual Acuity after 12<sup>th</sup> postoperative week**

Visual acuity	Number of patients (%) for patient groups	
	Group A (n=15)	Group B (n=15)
6/6	4 (26.6)	3 (20.0)
6/9	4 (26.6)	4 (26.6)
6/12	4 (26.6)	6 (40.0)
6/18	1 (6.6)	0 (0.0)
6/24	1 (6.6)	1 (6.6)
6/36	1 (6.6)	1 (6.6)
6/60 or less	0 (0.0)	0 (0.0)

**Discussion:**

The preoperative mean endothelial cell density was  $2620 \pm 70.20 / \text{mm}^2$  in group A and  $2625 \pm 71.10 / \text{mm}^2$  in group B. These values have a similarity with the findings of Brightbill who reported that mean endothelial cell count in late adulthood was around 2,500 cells /mm<sup>2</sup> and Indians have slightly lower counts.<sup>13</sup> In the present study, after 1st postoperative week, endothelial cell loss was 7.63% in group A and 8.19% in group B. After 4th postoperative week, there was further decrease in endothelial cell loss to 3.09% in group A and 2.90% in group B. At 12<sup>th</sup> postoperative week, there was further decrease in endothelial cell loss by 1.49% in group A and 1.28% in group B. These findings were similar to a study which was done by Li and coworkers who found an average endothelial cell loss of 9.74% in 107 patients of phacoemulsification at 1st postoperative week.<sup>14</sup>

Central corneal thickness of all the patients was measured preoperatively and postoperatively after 1st, 4th and 12<sup>th</sup> weeks.

Mean preoperative values were  $530 \pm 40.90$  micrometer in group A and  $532 \pm 30.56$  micrometer in group B. After 1<sup>st</sup>, 4<sup>th</sup> and 12<sup>th</sup> postoperative week, the central corneal thickness was  $545 \pm 40.50$  micrometer,  $535 \pm 40.02$  micrometer,  $532 \pm 39.85$  micrometer respectively in group A and  $547 \pm 43.98$  micrometer,  $537 \pm 41.23$  micrometer,  $533 \pm 40.63$  micrometer respectively in group B. The similarity of results in these two groups is supported by a study done by Srinivisan et al,<sup>15</sup> who found that there was initial loss of endothelial cell count, increase in central corneal thickness and these values subsequently become normal after 12<sup>th</sup> weeks of surgery.

**Conclusion:** The two techniques of nuclear management are equally effective. The endothelial cell loss and central corneal thickness changes were almost equal in these two methods.

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