

A Study of Corneal Endothelial Damage Following Different Type of Phacoemulsification Techniques

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Abstract: Background: Cataract is one of the leading cause of visual disability throughout the world, responsible for 51.3% of blindness (2.2 billion)^[1]. Cataract is held to be responsible for 80% of bilateral blindness in India^[2]. Aim: To evaluate and compare Corneal endothelial changes following Divide – conquer versus. Stop-chop Phacoemulsification techniques. Settings and Design: A open label, randomised comparative study Methods and Material: A comparative study is done on 62senile cataract eyes that were prepared to have phacoemulsification surgery from February 2021 to August 2022 at our tertiary eye care Hospital. Total eyes were divided into two groups; each group had 31 eyes. One group subjected to ‘stop and chop’ phacoemulsification technique and other group subjected to ‘divide and conquer’ phacoemulsification technique. Statistical analysis used: The Statistical software namely SPSS 22.0, and R environment ver.3.2.2 were used. Results: Gender distribution of our study population was found to be 29 females (46.8%), 33 males (53.2%) In stop and chop, percentage of endothelial cell loss from preoperative cell count was 4.7%, 5.07%, 6.09%, 7.33%, 7.89% at POD 1, POD 1st week, POD 2nd week, POD 1month, POD 6th week respectively. In divide and conquer, percentage of ECL from preoperative cell count was 6.95%, 7.41%, 8.13%, 9.23%, 10.03% at POD 1, POD 1st week, POD 2nd week, POD 1month, POD 6th week respectively. In stop and chop, Percentage of Central corneal thickness increase from pre-operative CCT was 4.6%, 5.8%, 4.02%, 2.01%, 1.60% at POD 1, POD 1st week, POD 2nd week, POD 1month, POD 6th week respectively. In divide and conquer, Percentage of CCT increase from pre-operative CCT was 7.8% , 7.2%, 5.4%, 4.6%, 3.8% at POD 1, POD 1st week, POD 2nd week, POD 1month, POD 6th week respectively. Conclusions: Our study shows that there is significant percentage of endothelial cell loss in both groups post-operatively as compared to preoperative endothelial cell count. The study concluded that, there was no statistically significant difference between divide & conquer technique and stop & chop technique regarding endothelial cell loss. Increased CCT values were observed in divide & conquer technique as compared to stop & chop technique. Both stop & chop technique and divide & conquer technique are equally efficacious for nuclear cracking in nuclear sclerosis grading 2, 3 and 4. But divide and conquer technique requires more ultrasound energy and effective phaco time compared to stop and chop technique

Keywords: Divide and conquer, Stop and chop, endothelial cell count, central corneal thickness

1. Introduction

Cataract is held to be responsible for 80% of bilateral blindness in India^[2]. The main cause of curable and treatable blindness worldwide, is cataract with developing world accounting for three fourth of blindness^[2]. Cataract poses a significant public health challenge and it is responsible for a visual acuity of 6/60 or worse in more than 100 million world population^[2]

Phacoemulsification is a type of ECCE which was introduced by Charles Kelman in 1967 and rapidly gained importance in 1980s. It is a sutures less technique in which an ultrasonic hand piece containing piezoelectric crystal in the titanium needle is used, which vibrates at an ultrasonic speed of 4000 per second and emulsifies the nucleus^[3]. The common nucleotomy techniques used in phacoemulsification are divide and conquer, stop and chop, direct chop or phaco-chop^[3].

Subjects and Methods

A open label comparative study is done on 62 senile cataract eyes who underwent Phacoemulsification surgery at our tertiary eye care Institute from February 2021-August 2022.

Inclusion Criteria:

The institutional ethical committee approval was obtained.

- 1) Individuals willing to give informed written consent
- 2) Age more than 50 years with significant cataract

Exclusion Criteria:

- 1) Subjects is not willing to give informed consent
- 2) Age less than 50 years
- 3) Complicated cataract
- 4) Pseudoexfoliation syndrome
- 5) Any diagnosed ocular disease
- 6) Any corneal irregularities such as corneal opacities
- 7) Unavailability for follow up
- 8) Any posterior segment pathology such as diabetic retinopathy.

Patients fulfilling the inclusion criteria were enrolled for the study.

Best corrected Visual acuity (BCVA) was noted done using LogMAR chart. Details of Anterior segment evaluation which was done using Slit lamp biomicroscopy and posterior segment by ophthalmoscopy (direct and indirect) and +90 D

Biomicroscopy were noted. The Central corneal thickness was measured by pachymetry, measurement of specular endothelial cell count and intraocular pressure were noted.

Among the study population, 29 (46.8%) were females and 33 (53.2%) were males.

The Statistical software namely SPSS 22.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc. Chi-square test has been employed to find the significance of study parameters on categorical scale between two or more groups, non-parametric setting for qualitative data analysis

2. Results

Table 1: Gender distribution in study group

Sex	Frequency	Percentage
Male	33	46.8%
Female	29	53.2%

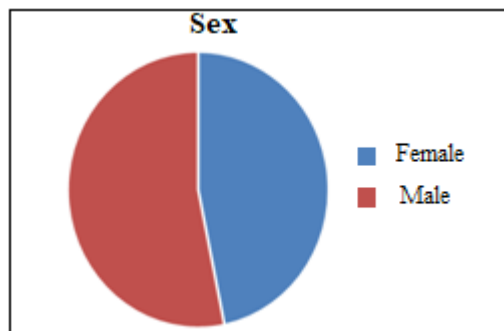


Figure 1: Pie chart showing Sex distribution among study population

Table 2: Comparison between the two studied groups according to endothelial count

Duration		Stop and chop (cells/mm2)	Divide and conquer (cells/mm2)	P value
Pre -op	Min-max	1923-2877	2047-2989	0.526
	Mean±SD	2369.87±222.126	2415.00±236.324	
	Median	2345.00	2372.00	
POD1	Min-max	1934-2886	1884-2825	0.321
	Mean±SD	2265.06±235.93	2250.16±235.93	
	Median	2233.00	2207.00	
POD week 1	Min-max	1923-2877	1870-2814	0.435
	Mean±SD	2253.19±222.63	2246.23±236.97	
	Median	2226.00	2196.00	
POD week 2	Min-max	1946-2853	1855-2801	0.504
	Mean±SD	2234.10±221.68	2228.68±235.11	
	Median	2202.00	2179.00	
POD 1 month	Min-max	1877-2828	1828-2771	0.526
	Mean±SD	2209.42±223.56	2209.58±244.65	
	Median	2173.00	2153.00	
POD week6	Min-max	1858-2813	1812-2755	0.508
	Mean±SD	2189.45±222.86	2186.42±238.26	
	Median	2160.00	2134.00	

P value was showing following results;

P= 0.526, P= 0.321, P=0.435, P=0.504 , P = 0.526 , P= 0.508 at pre-operatively, POD1, POD 1st week, POD 2nd week, POD 1month, POD 6th week respectively. As shown

above there was no statistically significant difference between two groups at all study periods.

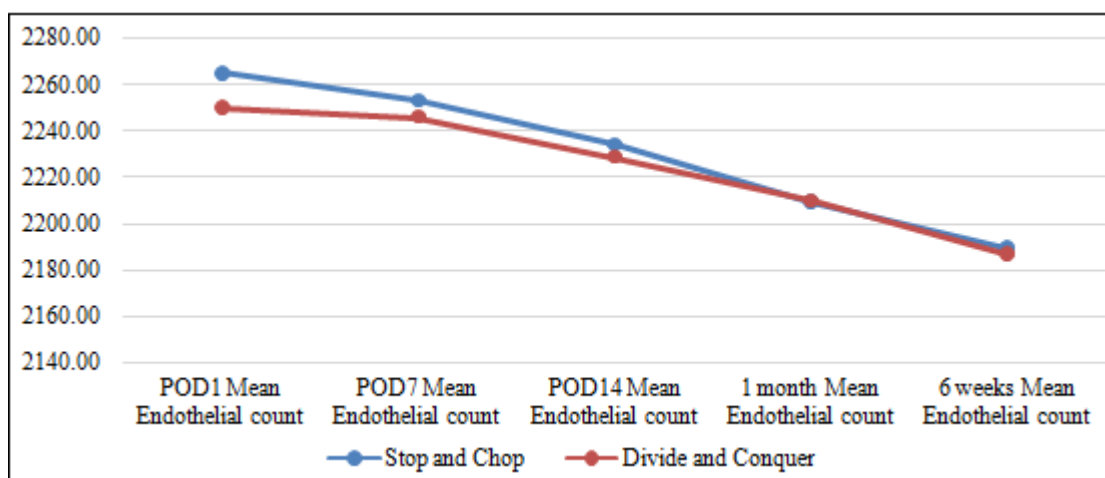


Figure 2: Line diagram showing endothelial count between two groups

Line diagram showing significant and equal fall of endothelial cell count in both study techniques.

Table 3: Comparison between the different studied periods according to endothelial cell count

Endothelial count	Pre-op	POD1	Week1	Week2	1month	Week6	P value
STOP – CHOP							0.001
% of decrease	-	4.77%	5.07%	6.09%	7.33%	7.89%	
P1		<0.001	<0.003	<0.002	<0.001	<0.021	
DIVIDE-CONQUER							0.004
% of decrease	-	6.95%	7.41%	8.13%	9.23%	10.03%	
P1		<0.001	<0.001	<0.001	<0.0021	<0.023	

In stop and chop, Percentage of endothelial cell decrease from pre-operative cell count were 4.77%, 5.07%, 6.09%, 7.33%, 7.89% at POD 1st week, POD 2nd week, POD 1month, POD 6th week respectively. In divide and conquer, Percentage of endothelial cell decrease from pre-operative cell count was 6.95% , 7.41%, 8.13%, 9.23%, 10.03% at POD 1st week, POD 2nd week, POD 1month, POD 6th week

respectively. Significant endothelial cell loss was noted in postoperative period compared to preoperative period in both groups. But there was statistically significant difference when compared between the two groups related to the studied periods according to Friedman’s two way analysis of variance.

Table 4: Comparison of central corneal thickness in between two groups

Pachmetry	Stop and chop (µm)	Divide and conquer (µm)	P
Pre-op			
Min-Max	440-561	440-560	0.394
Mean±SD	495.94±31.13	502.94±33.08	
Median	497	500	
POD1			
Min –Max	462-584	479-601	0.009
Mean±SD	519.26±31.42	543.29±31.52	
Median	520	539	
POD week1			
Min –Max	469-589	476-596	0.121
Mean±SD	524.94±31.40	538.39±33.05	
Median	526	536	
POD week2			
Min –Max	461-580	467-588	0.112
Mean±SD	516.16±31.02	530.00±33.15	
Median	517	527	
POD 1month			
Min –Max	456-576	464-581	0.095
Mean±SD	510.84±31.02	524.84±32.84	
Median	507	523	
POD week6			
Min –Max	454-575	459-577	0.11
Mean±SD	511.90±31.02	522.00±33.55	
Median	505	519	

P value between two the groups was showing following results;

P= 0.394 , P= 0.009, P=0.121, P=0.112 , P = 0.095 , P= 0.11 at preoperatively, POD 1, POD 1st week, POD 2nd week, POD 1month, POD 6th week respectively. Statistically

significance was noted only during first postoperative and after 1 month. But p value was statistically not significant in other study periods.

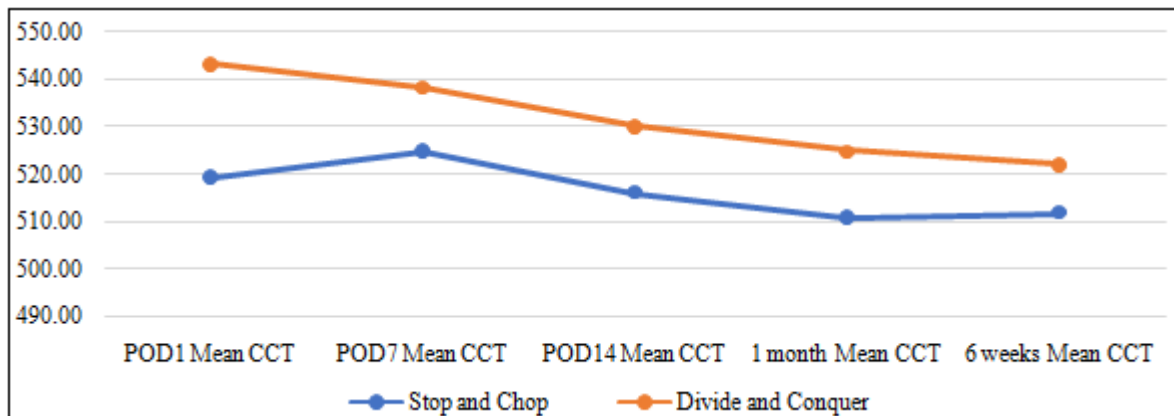


Figure 3: Line diagram showing Central corneal thickness between two groups

Line diagram showing significant increase in CCT values at immediate postoperative day in both groups.

Table 5: Comparison between the two studied groups according to % of change of CCT values

Pachymetry	Pre-op	POD1	POD week1	POD week2	POD 1month	POD week6	P
STOP AND CHOP							
% of increase	-	4.6%	5.8%	4.02%	2.01%	1.60%	0.0005
P1		0.001	0.002	0.025	0.092	0.010	
DIVIDE AND CONQUER							
% of increase	-	7.8%	7.2%	5.4%	4.6%	3.8%	0.002
P1		0.001	0.004	0.003	0.0084	0.006	

In stop and chop, Percentage of CCT increase from pre-operative CCT was 4.6%, 5.8%, 4.02%, 2.01%, 1.60% at POD 1, POD 1st week, POD 2nd week, POD 1month, POD 6th week respectively. In divide and conquer, Percentage of CCT increase from preoperative CCT was 7.8%, 7.2%, 5.4%, 4.6%, 3.8% at POD 1, POD 1st week, POD 2nd week, POD 1month, POD 6th week respectively. There was increase in CCT at immediate postoperative day and gradually reduced to near preoperative CCT in both groups

3. Discussion

Various techniques have been developed for cataract surgery in order to reduce damages to corneal endothelium. Phacoemulsification has gained acceptance as the standard technique for cataract surgery worldwide. The use of ultrasonic energy during nuclear emulsification is associated with endothelial cell loss. Thus, evaluation and comparing changes in corneal endothelium post divide and conquer versus stop and chop phacoemulsification technique are the main aims of the current study.

Gender distribution of our study population was found to be 29 females (46.8%), 33 males (53.2%). The study conducted by Madhumita Prasad et. al.^[5] showed 54% were males, 46% were females. Gender distribution of our study is similar to Madhumita Prasad et. al study^[5]. i. e males were more than females.

In stop and chop, Percentage of endothelial cell decrease from pre-operative cell count was 4.77%, 5.07%, 6.09%, 7.33% and 7.89% at POD 1, POD 1st week, POD 2nd week, POD 1month, POD 6th week respectively. In divide and conquer, Percentage of endothelial cell decrease from pre-operative cell count was 6.95% , 7.41%, 8.13%, 9.23%, 10.03% at POD 1, POD 1st week, POD 2nd week, POD 1month, POD 6th week respectively. In our study, Endothelial loss in stop and chop group was 7.33% at 1month and in divide & conquer group was 9.23% at 1month. Endothelial cell loss was significant in our study compared to Mohamed S. Mahmoud et, al^[6] study.

Percentage of increase from pre-operative values in central corneal thickness in stop-chop group was 4.6 % , 5.8 % , 4.02 % , 2.01 % , 1.06% at at 1st week, POD1month, POD 3month respectively in stop-chop group. Percentage of increase from pre-operative values in central corneal thickness in divide and conquer technique was 7.8 % , 7.2 % , 5.4 % , 4.6% , 3.8 % at 1st week, POD1month, POD 3month respectively in stop-chop group. Compared to Mohamed S. Mahmoud,

Sherief E. et., al^[7] study, there was significant increase in CCT at post-op 1st week in our study.

4. Conclusion

Our study shows that there is significant percentage of endothelial cell loss in both groups post-operatively as compared to preoperative endothelial cell count. The study concluded that, there was no statistically significant difference between divide & conquer technique and stop & chop technique regarding endothelial cell loss.

A significant increase in central corneal thickness at immediate post –operative week was observed among two studied groups. Increased CCT values was observed in divide & conquer technique as compared to stop & chop technique. Both stop & chop technique and divide & conquer technique are equally efficacious for nuclear cracking in nuclear sclerosis grading 2, 3 and 4. But divide and conquer technique requires more ultrasound energy and effective phaco time compared to stop and chop technique.

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