ORIGINAL ARTICLE

Comparative Study of Stop and Chop Versus Phaco Chop Nucleotomy Technique in Phacoemulsification

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Abstract

Objective: To carry out comparison between Phaco-chop Nucleotomy and stop-and-chop technique for phacoemulsification, in terms of operative time, phaco time, visual acuity, fluid volume, post-operative best corrected visual acuity, pachymetry, endothelial cell count and ultrasound power.

Methodology: A prospective comparative study was carried out on 50 patients (25 patients in each group) at the Department of Ophthalmology, Al Shifa Trust Eye, Hospital Jhelum Road, Rawalpindi Pakistan from 1st Nov 2021 to 31st January 2021. Patients in Group A were assigned to Phaco-chop Nucleotomy technique whereas patients in Group B were assigned to stop and chop technique through blocked randomization and non-probability consecutive sampling technique.

Results: Statistically significant improvement was observed in terms of post-operative best corrected visual acuity, phaco time, ultrasound power usage and operative time following Phaco-chop nucleotomy technique with p value < 0.01 was between both the groups for each variable using independent samples t test, Shapiro Wilk Test and On Way ANOVA Test.

Conclusion: Phaco-chop nucleotomy technique proved significantly superior to stop and chop technique specially in terms of post-operative best corrected visual acuity, phaco time, ultrasound power usage and operative time. *Al-Shifa Journal of Ophthalmology 2022; 18(3): 98-104.*

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Introduction:

In 1967, Kelman introduced phacoemulsification ultrasound in order to find out a more effective and safe way for the removal of cataractous lens but risk factor for tissue damage and endothelial cell is the US power required for traditional or longitudinal Phacoemulsification. Following cataract surgery, corneal endothelial cell loss cannot be avoided no matter what sort of cataract technique is followed [1,2]. Maintenance of corneal transparency is mandatory for corneal endothelium. This is due to the fact that barrier fluid pump and active fluid pump keep is in a state of continuous dehydration. These activities cannot afford any compromise which can lead to post a threat to corneal clarity. Today phacoemulsification with cataract extraction has been one of the most effective surgical procedures [3]. Corneal

endothelium maintains the normal corneal thickness and its transparency. In order to estimate the safety of certain surgical techniques endothelial alterations are considered important parameters in surgical trauma. It has been observed that endothelial cell density decreased with a faster rate once cataract surgery is carried out in a healthy and unoperated corneas[4]. Gimbel described a very interesting technique with the name divide-and-conquer was probably the first nucleofractis cracking technique came in practice so far[5,6]. Less endothelial cells are guaranteed with safe surgery in the aforementioned technique [7,8,9]. Nagahara in the year 1993 came up with his own technique used for nucleus cracking. The aim of this study is to carry out comparison between Phaco-chop and stop-and-chop nucleotomy for phacoemulsification, in terms of post-operative best corrected visual acuity, operative complications, ultrasound power and operative time.

Participants and Methods:

A prospective comparative study carried out at the Department of Ophthalmology, Al Shifa Trust Eye, Hospital Jhelum Road, Rawalpindi Pakistan from 1st Nov 2021 to 31st January 2021. This study was approved by the Hospital's Ethical Committee. However, prior to the conduct of study, informed consent forms were obtained from all patients according to Helsinki Declaration. Nonprobability consecutive sampling technique was used. Sample size was calculated using WHO sample size calculator. Our inclusion criteria was patients having age above 50 years of age presented with senile cataract confirmed on clinical examination of the patient. Our exclusion criteria included patients having eyes with very soft or very hard nuclei (grade 1 or 5). Patients having eyes with sunken globes and prominent supra orbital ridges and poorly dilated pupil. Patients having eyes with ocular pathology such as uveitis, glaucoma, corneal opacities, pseudoexfoliation syndrome, ocular hypertension, posterior segment pathology as diabetic retinopathy or endothelial cell density less than 1500 cells/mm2. Patients having eyes with previous intraocular surgery and patients having eyes with previous ocular trauma were confirmed on clinical examination. Patients were assigned to Group A and Group B through blocked randomization. Patients in Group A were subjected to phacoemulsification using the Phaco-chop Nucleotomy technique while in Group B, patients were subjected to phacoemulsification using stop and chop technique (horizontal/vertical chopping). Patients in both groups were subjected to clinical history which was followed by comprehensive clinical assessment of each patient in both groups. It included onset, course and duration of vision loss, history of previous ocular trauma or surgery, review of systemic diseases, detailed ophthalmic examination, including visual acuity assessment. Refraction of the patients was performed. Post op Best Corrected Visual Acuity (BCVA) was carried out at one week follow up. Slit lamp examination was done to assess corneal clarity, anterior chamber depth, state of pupil dilatation, lens morphology, nuclear grading, fundus examination and intraocular pressure using Goldman Applanation Tonometry. Peribulbar anesthesia was given to the patients and were operated by the researcher. Superior self-sealing clear corneal incision was made using 2.75 mm keratome and Nucleotomy was done after achieving capsulorhexis. Some parameters were measured during the surgery while some parameters were assessed at the time of follow up i.e at one week follow up. These parameters included age, operative time, phaco time, visual acuity, fluid volume, post-operative best corrected visual acuity, pachymetry, endothelial cell count and ultrasound power. Baseline data of the aforementioned variables was recorded, and patients were asked to report back after one week. After the follow up visit of all patients, data was

entered and analyzed using SPSS Version 23.0. Descriptive statistics was used for carrying out analysis. Normality of the data was tested using Shapiro Wilk Test. Mean and SDs were computed for continuous variables such as age, operative time, phaco time, visual acuity, fluid volume, post-operative best corrected visual acuity, pachymetry, endothelial cell count and ultrasound power. Both groups were compared using independent t test and one way ANOVA test considering P value < 0.05 as significant. All results were presented in the form of tables.

Results:

In Group A, mean and SDs for age was 64.80+4.43. In Group B mean and SDs for age was 63.64+5.60 (p= 0.421). In Group A, mean and SDs for pre-op visual acuity was 0.056+0.014. In Group B, mean and SDs for pre-op visual acuity was 0.564+0.146 (p= 0.991). In Group A, mean and SDs for ultrasonic power used was 54.96+3.385 while in Group B, mean and SDs for ultrasonic power was 61.16+2.56 (p < 0.01). In Group A, mean and SDs for operative time was 55.80+1.68 while in Group B, mean and SDs for operative time was 64.92+2.66 (p< 0.01). In Group A, mean and SDs for phaco time was 10.14+0.49 while in Group B, mean and SDs for phaco time was 9.47±0.399 (p < 0.01). In Group A, mean and SDs for fluid volume was 220.78+6.68 while in Group B, mean and SDs for fluid volume was 218.37+6.48 (p = 0.202). In Group A, mean and SDs for pachymetry at baseline was 534.99+15.30 while in Group B, mean and SDs for pachymetry was 540.96+15.12 (P = 0.172). In Group A, mean and SDs for pachymetry at one week follow up was 553.00+6.58 while in Group B, mean and SDs for pachymetry at one week follow up was 554.59+7.62 (P = 0.436). In Group A, mean and SDs for endothelial cell count at baseline was 2594.78+119.13 while in Group B, mean and SDs for endothelial cell count at baseline was 2579.58+106.58 (p = 0.637). In Group A, mean and SDs for endothelial cell count at one week follow up was 2489.00+93.69 while in Group B, mean and SDs for endothelia cell count at one week follow up was 2484.48+112.96 (p= 0.878). In Group A, mean and SDs for post op BCVA was 0.596+0.002 while in Group B, mean and SDs for post op BCVA was 0.556+0.016 (p < 0.01). (Table No. 1). Statistically significant improvement was observed in terms of post-operative best corrected visual acuity, phaco time, ultrasound power usage and operative time following Phaco-chop nucleotomy technique with p value < 0.01 was between both the groups for each variable using independent samples t test, Shapiro Wilk Test and On Way ANOVA Test.

Table No. 1 Comparison of various parameters between Stop and Chop Versus Phaco Chop Nucleotomy Technique in Phacoemulsification (n=50)

		Mean	Std. Deviation	95% Confidence Interval for Mean		P Value (ANOVA)
				Lower Bound	Upper Bound	
Pre Op VA (decimals)	Group A	.0560	.01414	.0502	.0618	0.922
	Group B	.0564	.01469	.0503	.0625	
	Total	.0562	.01427	.0521	.0603	
US Power (%)	Group A	54.96	3.385	53.56	56.36	< 0.01
	Group B	61.16	2.561	60.10	62.22	
	Total	58.06	4.316	56.83	59.29	
Operative Time (minutes)	Group A	55.80	1.683	55.11	56.49	< 0.01
	Group B	64.92	2.660	63.82	66.02	
	Total	60.36	5.106	58.91	61.81	
Phaco Time (seconds)	Group A	10.1400	.49413	9.9360	10.3440	< 0.01
	Group B	9.4752	.39628	9.3116	9.6388	
	Total	9.8076	.55610	9.6496	9.9656	
Fluid Volume (mm3)	Group A	220.780	6.6865	218.020	223.540	0.202
	Group B	218.372	6.4847	215.695	221.049	
	Total	219.576	6.6313	217.691	221.461	
Pachymetry at baseline (microns)	Group A	534.996	15.3060	528.678	541.314	0.172
	Group B	540.964	15.1271	534.720	547.208	
	Total	537.980	15.3594	533.615	542.345	
Pachymetry at one week follow up (microns)	Group A	553.008	6.5896	550.288	555.728	0.436
	Group B	554.592	7.6245	551.445	557.739	
	Total	553.800	7.0980	551.783	555.817	
Endothelial Cell Count at baseline (mm2)	Group A	2594.780	119.1379	2545.602	2643.958	0.637
	Group B	2579.580	106.5808	2535.586	2623.574	
	Total	2587.180	112.1376	2555.311	2619.049	
Endothelial Cell Count at one week follow up (mm2)	Group A	2489.008	93.6958	2450.332	2527.684	0.878
	Group B	2484.480	112.9673	2437.849	2531.111	
	Total	2486.744	102.7409	2457.545	2515.943	
Post OP BCVA (decimals)	Group A	.59636	.002970	.59513	.59759	< 0.01
	Group B	.55696	.016326	.55022	.56370	
	Total	.57666	.023041	.57011	.58321	

Group A = Phaco-Chop Nucleotomy Technique Group B = Stop and Chop Technique

Discussion:

Rare literature exists on the comparison of these two techniques, however, after thorough search, we found out that[11], Phaco-chop technique is much more superior to the stop and-chop technique specially, in terms of post-operative best corrected visual acuity, operative complications, ultrasound power and operative time. This contrasted with the findings concluded by Vajpayee et al, who reported no significant differences between the Phaco-chop and stop-and-chop groups in terms of in terms of post-operative best corrected visual acuity, operative complications, ultrasound power and operative time[12]. But Wong[14] et al, reported significant differences between both the techniques. This is consistent to the findings of our study where we have reported significant difference amongst various variables of interest.

Various studies exist in the literature whereby the recovery mechanism of Corneal Endothelial Cells (CEC) has been studied following endothelial damage. In this respect, a study by Hughes et al. expressed that due to the toxic endothelial injury there might be rise in central Endothelial Cells Density (ECD) which may be due to the cellular migration from less affected area [9].

As per the findings of this study, in Group A, mean and SDs for phaco time was 10.14+0.49 seconds while in Group B, mean and SDs for phaco time was 9.47_0.39 seconds. P Value 0.000. Can et al. and Storr-Paulsen, 2008 et al. 10,11 reported phaco time 14.9 and 12.79, respectively.

In the same manner, Vajpayee et al [12]. reported higher means as 28 seconds, while other studies reported much lower APT after Phaco chop technique: less than 10 in the study by Suzuki et al and 3.98 in the study by Storr-Paulsen et al[11, 13]. This discrepancy may be due to different Phaco machines. Wong et al, reported and attributed Endothelial Cells Loss (ECL) to the horizontal-chop technique which has the ability to significant shorter Phaco time and lower absolute Phaco power than the phaco chop technique. [14] They attributed loss of less energy to less ECL.

O'Brien et al, showed agreement with the above-mentioned study[15]. Storr-Paulsen et al, reported large fluid volume during surgery increases the risk corneal endothelium damage[11]. As per Centurion et al, the dynamics of fluid are required in order to maintain anterior chamber volume and remove any emulsified fragments specially to cool the titanium tip account to increase consume of solution[16].

In our study, as per fluid volume in both groups, in Group A, mean and SDs for fluid volume was 220.78+6.68 mm3 while in Group B, mean and SDs for fluid volume was 218.37+6.48 mm3. P Value = 0.202. Similarly, for endothelial cell count in both groups, in Group A, mean and SDs for endothelial cell count at one week follow up was 2489.00+93.69 while in Group B, mean and SDs for endothelia cell count at one week follow up was 2484.48+112.96. P Value 0.878. Subsequently, fluid volume and endothelium loss were found correlated in this study.

Kohlhaas et al, reported that endothelial cell is not correlated with central corneal thickness[17]. However, our findings also agreed with it as in our study, though we maintained one week follow up whereby we reported insignificant changes as in in Group A, mean and SDs for pachymetry at baseline was 534.99+15.30 while in Group B, mean and SDs for pachymetry was 540.96+15.12. P Value = 0.172. In Group A, mean and SDs for pachymetry at one week follow up was 553.00+6.58 while in Group B, mean and SDs for pachymetry at one week follow up was 554.59+7.62. P Value = 0.436. It was irrespective of the severity of endothelial cell loss. These results were also in consistent to the finding established by Cheng et al. and Amon et al [18,19]. Finally, as per post op BCVA in our study, in Group A, mean and SDs for post op BCVA was 0.596+0.002 while in Group B, mean and SDs for post op BCVA was

0.556+0.016. P Value = < 0.01. (Table No. 1). It was inconsistent to the results concluded by Poyales-Galan and Pirazzoli, Park et al, who showed means of post op BCVA comparable to our findings[21-24].

This study has some limitations which is mainly attributed to its small sample size and single centered study due to which its results cannot be generalized to overall population. Hence, our recommend large multi-centered randomized control trials between these two techniques for better understanding and robust management of such patients in our local population.

Conclusion:

Phaco-chop nucleotomy technique proved significantly superior to stop and chop technique specially in terms of post-operative best corrected visual acuity, phaco time, ultrasound power usage and operative time.

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