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Original Article

Comparison of Stop and Chop and Phaco Chop Nucleotomy Techniques in Phacoemulsification.

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Abstract

Background: Cataract extraction with intraocular lens implantation (IOL) is the standard treatment in managing the reversible blindness due to cataract. With advances in techniques and equipment there is dramatic increase in the popularity of phacoemulsification.

Objective: To assess the efficacy of stop and chop and phaco chop nucleotomy techniques in terms of intraoperative parameters such as: a) Mean phaco time (min), b) Mean phaco power (%), c) Effective phaco time (EPT)= phaco time (sec) x mean phaco power /100 and to document the intraoperative and postoperative complications, if any and compare the efficacy and safety between the techniques.

Methods and Material: Prospective interventional study. A total of 88 patients were included in the study and were divided into two groups of 44 each. Patients in Group A underwent stop and chop nucleotomy and underwent phacochop nucleotomy technique in Group B. The parameters -MPP, MPT and the EPT were recorded, any intra and post-operative complications were recorded and compared between the two groups. Chi square test and paired t test.

Results: The MPT, MPP and the EPT in Group A and Group B were 1.533,26.336,25.003 and 1.1332, 24.718 and 17.809 respectively with the 'p' values being <0.05.There were nil intra operative complications.

Conclusion: The phaco chop nucleotomy technique is more efficacious compared to the stop and chop nucleotomy technique in terms of intra-operative parameters. It depends on the surgeon's skill and precision to choose which nucleotomy technique to perform.

Keywords: Phaco chop nuleotomy, Stop and chop nucleotomy, Phacoemulsification.

Introduction

Cataract extraction with intraocular lens implantation (IOL) is the standard treatment in managing the reversible blindness due to cataract. With advances in techniques and equipment there is dramatic increase in the popularity of phacoemulsification due to early visual rehabilitation with least astigmatism.

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This technique involves the fragmentation and emulsification of nucleus with ultrasound (US) energy through a small sclera-corneal tunnel or clear corneal incision followed by implantation of a foldable IOL.

The use of ultrasonic energy during nuclear emulsification is invariably associated with endothelial cell damage which can also be due to irrigation flow, turbulence, phaco time, and phacopower needed for emulsification.[1,2]

Minimizing the corneal endothelial damage is crucial and many techniques have been developed to decrease the above mentioned effects and two such techniques are the stop and chop and phaco chop.[3,4]

In the stop and chop technique of phacoemulsification a central groove is created using ultrasound energy followed by nucleus fracture and

aspiration of emulsified fragments,

whereas in the phaco chop technique the nucleus is directly fractured into two halves without prior grooving or sculpting using minimal mechanical force instead of ultrasound energy.

The advantages of the stop and chop nucleotomy technique are it is a safe technique and is easy to perform and is useful for all grades of nucleus. But it requires more phaco power and time.

The advantage of the phaco chop technique is that this technique requires less phaco time and power; however, there is a risk of damage to the capsule.

It is important to shorten the phaco time and reduce the phaco power to protect the corneal endothelium in phacoemulsification.

Analysis of various parameters between the stop and chop, and phaco chop techniques showed variable results.[5,6,7] Hence we have undertaken this study to compare the safety and efficacy of these two techniques in phacoemulsification.

Material and Methods

Source of Data: This was a prospective interventional study conducted in the Department of Ophthalmology in R.L.J. Hospital and Research Centre attached to Sri Devaraj Urs Medical College from January 2019 and June 2020.

Approval from institutional ethics committee was taken. Written informed consent was taken from all the patients who underwent cataract surgery.

Study Design: Prospective interventional study.

Study Period: January 2019 and June 2020.

Sample Size Estimation

The sample size has been estimated based on the effective phaco time between the two nucleotomy technique based on an article by Noopur Sharma et al[8]. Repeated variance estimate of 15.6 in mean effective phaco time in a study with 95% confidence interval with 80 % power considering type 1 error of 5% to detect a mean difference of 7 % in mean phaco time, the required sample size per group will be 44 making a total of 88 patients.

Formula

$$n = 2Sp^2[Z1-\alpha/2 + Z1-\beta]^2$$

$$\mu^2 d$$

$$S^2_p = S_1^2 + S_2 2$$

2

S_1^2= standard deviation in first group
S_2^2= standard deviation in second group
μ^2= mean difference between sample
α= significance level
$1-\beta$ = power

Inclusion Critera:

All the patients with senile cataract undergoing phacoemulsification.

Exclusion Criteria

Patients with subluxated or traumatic cataract, pseudoexfoliation, corneal disorders like corneal opacities, degenerations and dystrophies, and patients with coexisting ocular morbidities like uveitis and glaucoma were excluded from the study.

Method of Collection of Data

A total of 88 eyes fulfilling the inclusion criteria were included in this prospective comparative study. Informed consent was obtained from the patients. Patients were divided into two groups, Group A and Group B by simple randomization, who underwent similar protocol for standard cataract evaluation, with detailed history and examination which includes recording of visual acuity by Snellen's chart, grading of cataract by slit lamp examination, intraocular pressure by application tonometer, fundus evaluation, keratometry and A scan for IOL power calculation and all the surgeries were performed by a surgeon who is experienced in both the techniques, using ZEISS VISALIS 100 phaco unit.

Surgical Technique

The surgeries were performed by two surgeons who were both equally efficient at the same level in performing both the techniques of nucleotomy.

1. **Preoperative:**
   All patients were on oral tablet Ciprofloxacin 500mg twice daily &Ciprofloxacin 0.3%eye drops hourly one day before the surgery. Preoperative pupillary dilatation was achieved by instilling tropicamide 0.8% with phenylephrine 5%.
2. **Intraoperative:**
   All patients underwent phacoemulsification under peribulbar anesthesia through a sclerocorneal tunnel. After a careful well centered capsulorhexis of 5.5 mm, hydro dissection and hydro delineation, the cataractous nucleus was emulsified by stop and chop technique in Group A and phaco chop technique in Group B.

Group A:(44 eyes) –Stop and Chop nucleotomy.

After creation of a groove of about 90% of the nucleus thickness the nucleus was split and the nuclear halves will be fragmented, emulsified and aspirated with phaco probe.

Group B: (44 eyes) –Phaco Chop nucleotomy.

After aspirating the superficial cortex and epinucleus the phaco tip is buried in the center of the endonucleus with high vacuum and fractured mechanically with a chopper held in the other hand.

Same process was carried on for the nuclear halves, emulsified and aspirated with phaco probe. Intraoperative parameters like the mean phaco time, the mean phaco power and effective phaco time. Effective phaco time is defined as the product of phaco time and phaco power.

This was followed by a cortical wash by bimanual irrigation aspiration cannula and implantation of foldable IOL in the capsular bag.

The intra operative parameters such as the mean phaco time (min), the mean phaco power (%) and the effective phaco time were recorded and any intra operative complications were noted.

Postoperative

Topical medications include an antibiotic steroid eye drops that were used for 6 weeks in a tapering dose.

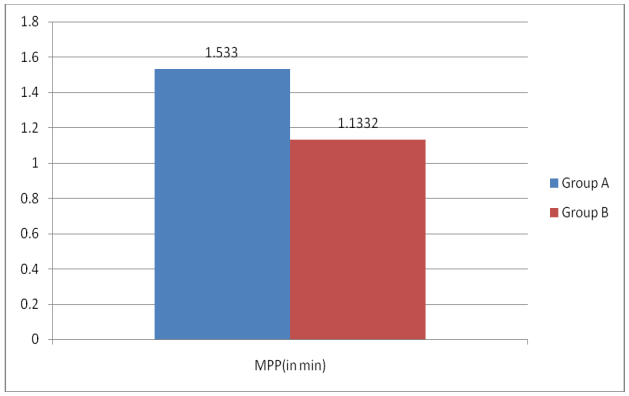
All patients were followed postoperatively on day 1 and day 7 and slit lamp examination was done, endothelial cell assessment was done using specular reflection in patients with corneal edema.

Results

Intra-Operative Parameters

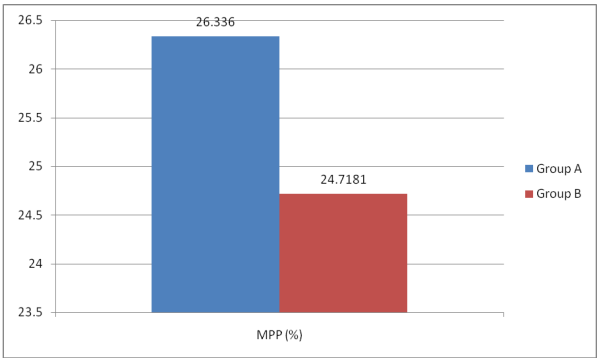
a) Mean Phaco Time (MPT in sec)

The mean phaco power (MPP) in group A is 1.533. The mean phaco power in group B is 1.1332. There is a significant decrease in the MPP in the patients of group B with a significant 'p' value and the value being 0.0001.



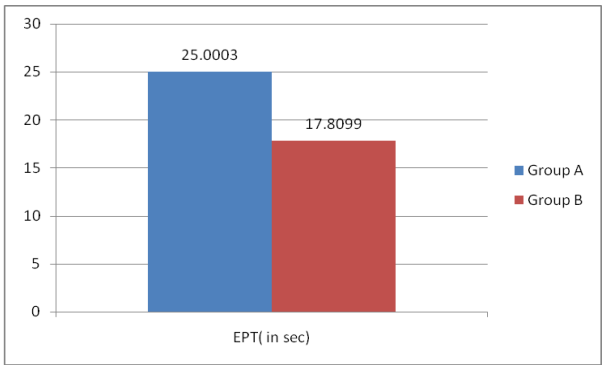
b) Mean Phaco Power (in %)

The mean phaco power (MPP) in the patients in Group A was 26.336 and the MPP in Group B is 24.718.Although there is a decrease in the MPP used in Group B, the difference is insignificant with the 'p' value being 0.67.



c) Effective Phaco Time (EPT in sec)

In group A the mean EPT was 25.0003 and in group B the EPT was 17.8099. There is a significant decrease in the EPT in group B compared to group A with the 'p' value being 0.0002.



There were nil intraoperative complications observed in either of the groups.

Post Operative Complications

In Group A, there were 5 patients who showed corneal edema on post-operative day 1 and all of them were managed by 5%NaCl eye drops twice a day for a week.

In Group B, there were 4 patients with corneal edema and were managed in a similar manner.

Visual Acuity on Day 1 & 7

In Group A, 39 out of 44 patients had visual acuity (VA) of 0.0

In Group B, 40 out of the 44 patients had visual acuity of 0.0

All the patients had a visual acuity of 0.0 on day 7.

Discussion

Mean Phaco Time

During the surgery the phaco machine keeps track of average phaco time. The mean phaco power (MPP) in group A is 1.533. The mean phaco power in

group B is 1.1332. There is a significant decrease in the MPP in the patients of group B with a significant 'p' value and the value being 0.0001. This was comparable with other studies.[3,4]

Mean Phaco Power

MPP is one of the parameters that determine the efficacy of a nucleotomy technique. Ultrasound power is varied by changing the amplification voltage of the handpiece. Increased voltage translates to increased stroke length at the phaco needle tip. Usually a maximum ultrasound power is preset on the machine's front panel, and the surgeon then titrates with linear pedal control the percentage of this preset maximum which is appropriate to a given intra-operative instant.

The MPP has been compared between the two groups and it was observed that the MPP used in Stop and Chop group was significantly less when compared to the phaco chop group. This can be attributed to the creation of central groove in the later which utilizes more phaco power. The same school of thought was put forward by Izzet Can et al[7]and Share if E el khouley[8]in their studies.

In the study by Izzet Can et al[7], the mean phaco power (in %) in the phaco chop group was 18.7 and in stop and chop group in was 20.0 with a significant 'p' value of 0.017, as compared to 26.33 and 24.21 in our study. However in a study by Vajpayee et al[6], with 20 patients in each group, there was no significant differences between the phaco chop and stop and chop groups. This may be due to a smaller sample size in the study.

Effective phaco time (EPT)

It is the calculated time required if 100% power has been used throughout. The EPT was calculated with the following formula: phacotime (seconds) x mean phaco power /100. In our study the EPT used in stop and chop group was significantly more compared to that used in phaco chop group that is 25.00 in Group A and 17.0 in Group B.

Similar to our study, in the study by Izzat can et al[7]the EPT used in stop and chop group was 22.3 and in phaco chop group, it was 14.9 with a significant 'p' value of 0.021. Similarly, in a study by Noopur Sharma et al[9], the EPT used in stops and chop group was higher compared to that in phaco chop group with a significant 'p'value of 0.01. However, Vajpayee et al showed that although less EPT was consumed in the phaco chop group, the difference was insignificant.

Intraoperative complications

Various intraoperative complications like posterior capsular rupture, anterior capsular rupture, nucleus drop and vitreous loss are related to the technique of nucleotomy. The centrifugal movements in the phaco chop technique is farther from the zonules, whereas creating the groove in the stop and chop technique increases the stress on the zonules with movement towards them. As a result, the nucleus separation process is done manually instead of by ultrasound energy as in the phaco chop technique which results in less damage to intraocular tissues. However, the incidence of complications also depends on the surgeon's skill and precision. In our study, we haven't observed any intra-operative complications with either of the techniques. A study done by Noopur Sharma et al, also showed nil intra operative complications.

Post operative complications

There are additional possible risks for corneal endothelial cell damage related to ultrasonic power in phacoemulsification when compared to ECCE. Such factors are mechanical damage by turbulence, air bubble, release of free radicals, greater irrigation volume, and direct trauma from surgical instruments, lens fragments, and the IOL according to Dick et al.

Corneal edema is one of the post-operative complication which is associated with endothelial cell loss.

In our study out of 88 patients, we observed a total of 9 cases of corneal edema in which 5 cases of corneal edema were in Group A and 4 cases in Group B. In a similar study by Izzet Can et al[7], there were nil post-operative complications. This can be attributed to various factors like nuclear density, phaco machine used, the surgical technique. However, the phaco chop technique consumed less MPP which was statistically significant.

Other complications like glaucoma and iritis were not encountered in our study. Visual acuity: The visual acuity on day 7 in both the groups was 0.0. This implies that both the techniques are equally efficacious. In the study done by Noopur Sharma et al, 100 % of the patients in both the groups achieved BCVA of 0.0. Several other studies done by Poyal Galen et al and Park et al[10] have shown comparable results.

There were no intra operative complications and the post-operative visual acuity on day 7 in the patients of both the groups is same. Hence, both the nucleotomy techniques are equally safe in terms of post-operative visual acuity.

However, the phaco chop nucleotomy technique has consumed less MPP, MPT and EPT which was significant. Hence is more efficacious when compared to the stop and chop nucleotomy technique.

Similarly, Izzet Can et al[7]in their study concluded that the phaco chop technique was a superior technique when compares to the stop and chop technique as it consumed less phaco parameters and decreased the corneal healing time. This was comparable to another study done by Shereief E El Khouley et al.

Conclusion

The pahco chop nucleotomy technique is more efficacious compared to the stop and chop nucelotomy technique in terms of intraoperative parameters, the phaco chop nucleotomy technique consumed significantly less MPP,MPT, and EPT when compared to the stop and chop technique.

However, there were nil intra operative complications like anterior capsule tear, rhexis runway and posterior capsular tear in both the groups. Hence both the techniques are equally safe to perfom.

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