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Original Article

Study of Nuclear Hardness and Phaco Time in Phacoemulsification

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Abstract

Introduction: Hardness of the cataractous lens is one of the major factors influencing the suitability of a patient for phacoemulsification. Phacoemulsification machines can measure the average phaco power and the phaco time (the amount of total time spent on the foot pedal at position 3). Effective phaco time (EPT) is a parameter that allows us to compare different phaco settings. EPT can be considered the product of phaco time multiplied by average phaco power.

Purpose: This study was undertaken to correlate the grade of nuclear hardness (graded according to lens opacities classification system III [LOCS III]) with the phaco time (both total and effective) in phacoemulsification, by recording the grade of nuclear cataract and the phaco time during each surgery.

Materials and Methods: In this study, 50 eyes undergoing phacoemulsification were studied. All cases were operated on using the same machine and under similar operative conditions. Nuclear hardness was graded according to color as seen under the slit lamp in accordance to the LOCS III grading system. In all the cases, the nucleus was then phacoemulsified using the stop and chop technique. The total phaco time and the EPT displayed on the phaco machine panel were noted carefully for each case.

Results: Nuclear hardness was graded based on LOCS III. Of the 50 eyes studied, 9 were of Grade 1, 16 were of Grade 2, 19 were of Grade 3, 5 were of Grade 4, and 1 was of Grade 5. Individual EPT for each case was charted against grades of nuclear cataract. The mean and standard deviations for Grades 1, 2, 3, and 4 were 0.2244, 0.7825, 1.80737, and 2.874, respectively, and 0.04096, 0.42399, 0.59038, and 0.36957, respectively. *P* value for the above as calculated using one-way ANOVA was 0.00, which is significant.

Conclusion: In this study, EPT varies significantly with different grades of nuclear sclerosis.

Key words: Cataract, Effective phaco time, Lens opacities classification system, Phacoemulsification, Phaco time

INTRODUCTION

Phacoemulsification machines can measure the average phaco power and the phaco time (the amount of total time spent on the foot pedal at position 3). The absolute amount of phaco energy delivered into the eye at 100% power, known as absolute phaco time (APT). Effective phaco time (EPT) is a parameter that allows us to compare different phaco settings. It is calculated by multiplying the total phaco time by the percentage power used and represents how long the phaco time would have been if 100% power, continuous mode had been utilized. More specifically, EPT can be considered the product of phaco time multiplied by average phaco power. A low APT results in clearer cornea and sharper vision on the first post-operative day, thus achieving a high patient satisfaction rate, lower corneal endothelial cell loss, lesser corneal decompensation, and a dramatically reduced incidence of pseudophakic bullous keratopathy. Hardness of the cataractous lens is one of the major factors influencing the suitability of a patient for phacoemulsification. This study was undertaken to correlate the grade of nuclear hardness (graded according to LOCS III) with the phaco time (both total and effective) in phacoemulsification, by recording the grade of nuclear cataract and the phaco time during each surgery.

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MATERIALS AND METHODS

In this study, 50 eyes undergoing phacoemulsification were studied. All cases were operated on using the same machine and under similar operative conditions. Inclusion criteria: Patients with clear cornea, normal anterior chamber depth, and intact zonules were included in the study. Exclusion criteria: Patients with corneal pathology, shallow anterior chamber, raised intraocular pressure, complicated cataract, traumatic cataract, eyes with evidence of glaucoma or fundus pathology, zonular dialysis, and small pupil were excluded from the study.

The clarity of the anterior chamber was confirmed in all cases and any obvious pathology was ruled out. The iris color, being related to dilatation of the pupil, was graded carefully preoperatively. The maximum pre-operative pupillary diameter was measured with the horizontal slit of the slit lamp. The nuclear hardness being the most important determinant in phacoemulsification was graded carefully. The low magnification view of the slit lamp with slit beam oriented at 45° to the patient's visual axis was used. The slit height exceeded slightly the diameter of the pupil and the width was adjusted so that the overall brightness of the slit image was good. Nuclear hardness was graded according to color as seen under the slit lamp in accordance to the LOCS III grading system. If the cortex was very hazy, the brightness of the beam was increased to gain penetrance into the lens substance. The irrigating solution used in all cases was standard balanced salt solution. The bottle was hung at an approximate height of 60 cm above the patient, and the tubing was connected to the phacoemulsifier probe through a sterile silicone tube which was passed through the pinch roller mechanism after passing through a pinchcock mechanism meant to cut off the flow. The phaco tip was then connected by a separate (inbuilt) wiring to the ultrasound generator through the adapter provided. Using the foot switch, the irrigation-aspiration mode was tested. Using the silicone tuning chamber, the ultrasound tip was tuned.

All standard pre-operative investigations of sac patency, intraocular tension, biometry, blood pressure, blood sugar (fasting and postprandial), and routine examination of urine were done. Patients with any abnormality in the above-mentioned investigations were excluded from the study.

Preoperatively, the patients were given tropicamide 1% with phenylephrine 2.5% eye drops (1 drop every 20 min, 3 times, about 90 min before surgery). Ketorolac 0.5% eye drops (1 drop every 15 min, 3 times) were given to sustain the papillary dilatation and to minimize post-operative cystoids macular edema.

Anesthesia constituted peribulbar block with 2% xylocaine and 1:200,000 adrenaline and hyaluronidase with no. 22, 1.5 inches hypodermic needle.

Thorough cleansing of the brow region and lids with 10% povidone-iodine solution was done. Topical 5% povidone-iodine solution was instilled 5 min before surgery.

About 3.2 mm clear corneal incision was made using keratome blade and anterior chamber was entered. Continuous curvilinear capsulorrhexis was carried out using 26-G bent needle and Utrata forceps. This was followed by hydrodissection and hydrodelineation of the nucleus. The nucleus was then phacoemulsified using the stop and chop technique: Using power based on the grade of nucleus, a central longitudinal trench was created with the 15° phaco tip in continuous mode. It was deepened by making successive passes toward 6 o'clock till red reflex was clearly visible. The trench was widened enough to allow access to successive deeper layers of the nucleus. The second instrument was used to avoid excessive nuclear movements while trenching. The nucleus was then rotated 180° and trenched in the opposite direction to get a trench of equal depth in both directions. The thinned out posterior plate was cracked to divide the nucleus into two hemisections by inserting the phaco tip and chopper into the depths of the groove and moving them in opposite directions. Once the nucleus was cracked into two further trenching was stopped and the two heminuclei were chopped. The phaco tip in pulse mode was then embedded at the junction of one-third and two-third of the heminucleus, and then, vacuum alone was used to hold the nucleus. The chopper was then embedded and was used to separate one-third of the nucleus from the remainder. This was repeated to split the remaining two-third into two. Three nuclear fragments were thus obtained. These three fragments were then removed using pulse mode, and similarly, the second heminucleus was chopped and removed. Any cortical matter left was aspirated, and foldable posterior chamber intraocular lens was implanted using a viscoelastic substance. The viscoelastic substance was then washed out.

The total phaco time and the EPT displayed on the phaco machine panel were noted carefully for each case.

Postoperatively, all patients were put on tapering dose of topical antibiotic and steroid combination for 6 weeks. Patients were followed up at 1st, 2nd, and 6th weeks postoperatively.

All details were compiled in individual case pro forma and a master chart with all studied parameters was prepared.

RESULTS

Of the 50 eyes operated on for cataract by phacoemulsification, 23 cases were from 51 to 60 years age group, 13 cases were from 61 to 70 years age group, 11 cases were from 41 to 60 years age group, and 3 cases were from 71 to 80 years age group [Figure 1]. Nuclear hardness was graded depending on nuclear color and opalescence based on LOCS III. Of the 50 eyes studied, 9 were of Grade 1, 16 were of Grade 2, 19 were of Grade 3, 5 were of Grade 4, and 1 was of Grade 5 [Figure 2]. The average age of patients with different nucleus grades was calculated. Those having Grade 1 nuclear cataract had an average age of 49.7 years, Grade 2 nucleus was seen in average age of 56.25 years, Grade 3 in 61.9 years, Grade 4 in 69.6 years, and Grade 5 in 75 years of age [Figure 3]. The average total phaco time for each nuclear grade was calculated. It was found to be 1.26, 2.42, 4.12, 5.02, and 8.23 min for Grades 1, 2, 3, 4, and 5, respectively [Figure 4]. Individual EPT for each case was charted against grades of nuclear cataract.

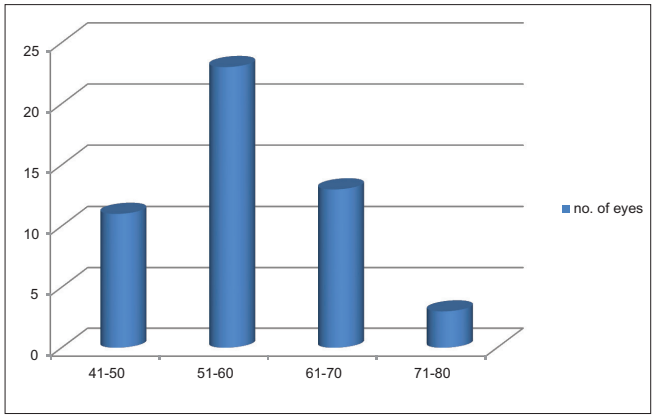

Figure 1: Age distribution of cataract

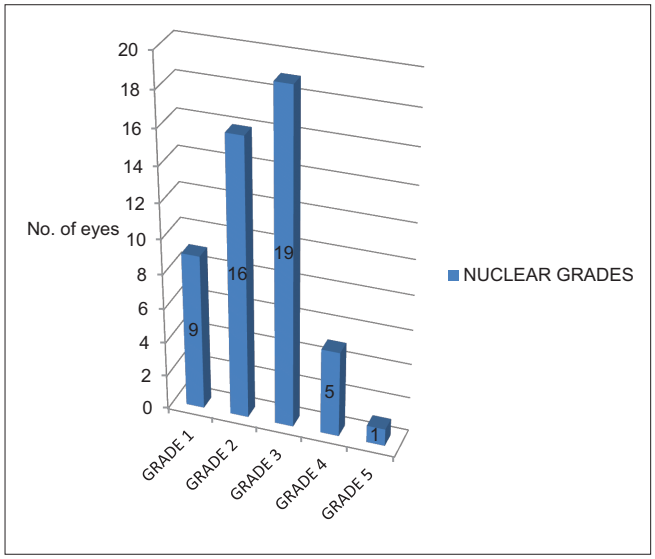

Figure 2: Nuclear hardness distribution

The mean and standard deviations for Grades 1, 2, 3, and 4 were 0.2244, 0.7825, 1.80737, and 2.874, respectively, and 0.04096, 0.42399, 0.59038, and 0.36957, respectively [Figure 5]. *P* value for the above as calculated using one-way ANOVA was 0.00, which is significant.

DISCUSSION

In eyes, this study a total of 50 eyes, with varying grades of nuclear cataract underwent phacoemulsification. All eyes were thoroughly evaluated preoperatively and the nature of the cataract was studied. Nuclear hardness graded at the slit lamp with respect to total phacoemulsification time of 4.12 min. The average phacoemulsification time increasing with respect to increasing grades of hardness Heyworth *et al.*[1] stated that lens hardness is probably the most important single factor and is associated with increased phaco time and power. According to Chylack *et al.*,[2] there is a well-known but poorly quantified clinical relationship between nuclear color and ease of phacoemulsification. This study has tried to define this relationship by correlating the increasing nuclear hardness to higher phacoemulsification time, both total and effective

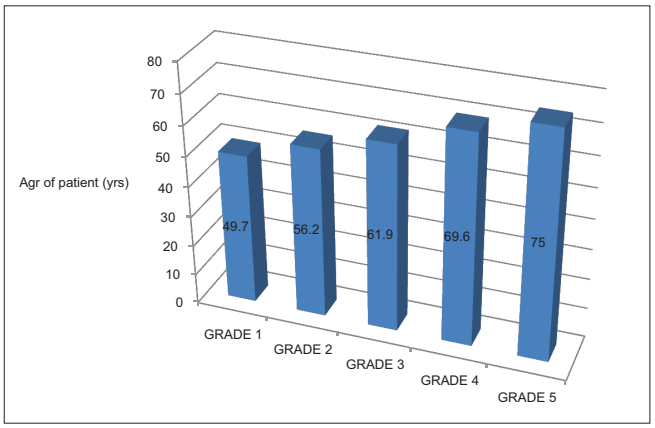

Figure 3: Age of patient compared to nuclear grade

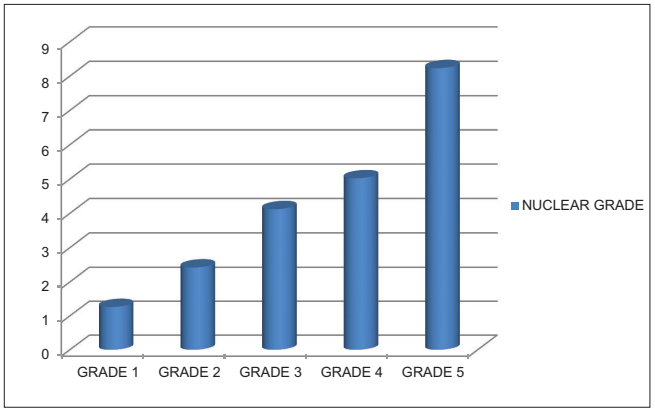

Figure 4: Nuclear grades compared to average total phaco-time

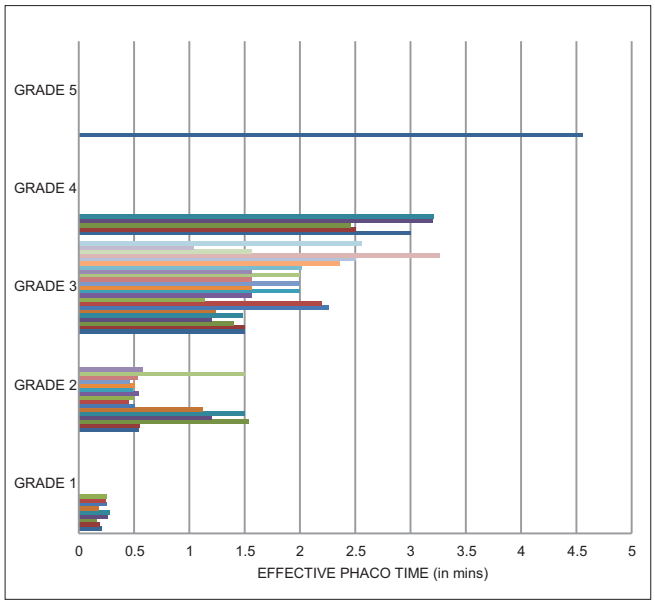

Figure 5: Grades of nuclear cataract and effective phaco time

Tabandeh *et al.*,[3] stated that assessment of hardness of a cataractous lens is a factor which influences the suitability of patient for phacoemulsification. Their study demonstrated that hardening of the lens nucleus is associated with coloration and advancing age. However, Gullapalli *et al.*[4] in their study have said that color is a better and reliable marker for nuclear hardness, diameter, and central thickness as compared to age. In this study, nuclear color was relied on to grade cataract. Age was taken into consideration but was only a secondary factor. All cataracts in this study underwent the same procedure without any variation of technique. Stop and chop technique of emulsifying nucleus was always undertaken. According to Howard V. Gimbel[5] variations of the basic technique should be adapted as one operates on nuclei of higher grades. It is obvious from this study that one nucleus of Grade 5 took 8.23 min to phacoemulsifier; as no variation was undertaken. Hence, for cataracts of Grades 4 and 5 nuclear hardness, a technique that decreases phacoemulsification time such as phaco chop should be adopted.

CONCLUSION

Phacoemulsification is an excellent procedure with gratifying results, if extreme care is taken with proper patient selection. The ease of the procedure depends on the hardness of the nucleus. In this study, it was noted that the EPT varied significantly with different grades of nuclear sclerosis.

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