



Mechanical Pupil Dilatation Using Oasis Ring versus Non-mechanical Device Pupil Dilatation for Phacoemulsification in Eyes with Narrow Pupil

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Case Report

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ABSTRACT

Purpose: to compare using Oasis ring for mechanical dilatation of the pupil during phacoemulsification in cases of narrow pupil with non-mechanical dilatation.

Methods: this study included 80 eyes of 67 patients of cataract with narrow pupil divided into 2 groups each of them included 40 eyes. In one group, Oasis ring was used to achieve adequate pupillary dilatation while in the other group, non-mechanical methods as bi-manual stretching, visco-mydrasis and partial sphinctrotomies were used. Both groups were compared regarding achieved pupil size, additional time for dilatation, intra-operative difficulties and post-operative pupil characters after one month. This study was conducted at Tanta University Hospital in Egypt.

Results: We found that the mean pupil size was 6.00±0.00 mm Oasis ring group while was 4.26±0.48 mm in the other group. Dilatation needed longer time with Oasis ring where it ranged from 83- 117 seconds. There was more liability for intra-operative difficulties as iris prolapse, minimal bleeding and iris trauma in the non-mechanical group. Post-operative pupil characters were rounded, central and reactive in the first group while oval pupil was found in 17.5% and minute tears in 12.5% of cases of non-mechanical group.

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Conclusion: Oasis ring offered more pupil dilatation with less liability for intra-operative complications and preservation of pupil characters. It added more cost and time to achieve adequate pupil dilatation.

Keywords: Oasis ring; narrow pupil; phacoemulsification.

1. INTRODUCTION

Phacoemulsification has become a gold standard of cataract surgery. This procedure in eyes with a narrow pupil which do not respond to standard preoperative pharmacological management is a challenge for any ophthalmic surgeon [1].

A 5.5 mm or larger pupil allows use of divide and conquer or other phacoemulsification techniques and a capsulorhexis of 4.0 to 5.0 mm could also be performed [2].

Poorly dilated pupil is one of the most common problems faced by cataract surgeons and is associated with a higher incidence of intra-operative complications such as capsular rupture and vitreous loss [3].

There are many causes of poor pupil dilatation e.g. diabetes mellitus, senile miosis, intraoperative floppy iris syndrome, pseudoexfoliation syndrome, uveitis with posterior synechiae and some conditions after ocular surgery [1].

The goal of managing miotic pupils is to achieve adequate pupil size to perform phacoemulsification while still maintaining pupillary reactivity, near normal pupil contour and excellent visual results [4].

Several methods had been developed for enlarging miotic pupils during phacoemulsification including iris retractors, multiple sphincterotomies and pupil stretch techniques [5].

Several types of iris retractors and devices are available to manage small pupils. A simple popular method involves using iris hooks to stretch the pupil at different meridians until reaching adequate size. The disposable Malyugen pupil expansion device is a foldable square made of 5-0 polypropylene with a coiled scroll at each 4 corners. Oasis iris expander is a device used for insufficient dilated pupils during ophthalmic surgery and sustaining visibility through the procedure. It is a molded polypropylene ring has four pockets that cradle

the delicate ocular tissue without potential tearing. Once the expander is removed the iris returns to its normal shape and function [6-11].

Healon GV (Sodium Hyaluronate) is a highly viscous agent which adds expansion power to the pupil and maintaining its size [2].

Multiple partial sphincterotomies with good post-operative function had been reported. Care must be used to avoid totally transecting the iris sphincter. Due to its invasive and destructive nature, sphincterotomy is not an option in today's modern cataract surgery technique. [2,9].

2. PATIENTS AND METHODS

This is a prospective randomized study. It was done in Ophthalmology Department, Tanta University Hospital in Egypt in the period from October 2013 to September 2016. The authors declare that there is no conflict of interest regarding the publication of this paper. Informed consent was obtained from every participant in this study and ethical committee approval was obtained.

The study included 80 eyes of 67 patients with cataract in which adequate pupil dilatation (> 5 mm) could not be achieved (as measured by the caliper) pharmacologically either pre-operatively or intra-operatively and so narrow pupil was considered.

The preoperative pharmacologic regimen used in these 80 eyes was as follows:

Phenylephrine 2.5% eye drops (Phenylephrine Hydrochloride Ophthalmic Solution USP 2.5%; Paragon Biotech Inc., Portland, USA) Tropicamide 1% eye drops (Mydracyl; Alcon Laboratories Inc., Fort Worth TX, USA) and cyclopentolate 1% eye drops (Colircusi Cicloplejico; Alcon Cusi, SA, Barcelona, Spain) were instilled three times at ten minutes intervals starting one hour before surgery. Nepafenac 0.1% eye drops (Nevanac; Alcon Laboratories Inc.,

Fort Worth TX, USA) was also administered 4 times daily starting 1 day before surgery.

Intra-operatively to achieve adequate dilatation, Healon GV or healon 5 (Abbot medical optics, Inc. USA) was used.

These eyes were divided into two groups:

- 40 eyes with narrow pupil were dilated without using internal device. They were dilated with bimanual pupil stretching (stretch pupilloplasty) and partial sphincterotomies when needed (non-mechanical dilatation group). (Fig. 1).
- 40 eyes with narrow pupil in the mechanical dilatation group were dilated using Oasis iris expander by a well-trained surgeon (Oasis; Oasis Medical Inc., Glendora CA, USA). (Fig. 2).

All patients underwent standard phacoemulsification by the same surgeon through a 2.8 mm superior clear corneal incision with a foldable lens implantation.

Follow-up of all cases after 1 month to evaluate characters of the pupil subjectively regarding shape, position, reactivity to light and iris trauma.

2.1 Statistics

Statistical presentation and analysis of the present study were conducted using the mean, standard deviation, chi square, and T test by SPSS V.20.

3. RESULTS

The study included 80 cases of 67 patients with narrow pupil due to various causes. The right eye was operated in 53 cases and the left eye in 27 cases. Age of the patients ranged from 47-73 years in the mechanical dilatation group with a mean of 64.8 ± 8.2 while it ranged from 52-78 years in the non-mechanical dilatation group with a mean of 59.9 ± 9.3 . The mechanical dilatation group included 21 male and 13 female patients (6 bilateral cases) while the non-mechanical dilatation group included 16 male and 17 female patients (7 bilateral cases).

Regarding causes of narrow pupil, many causes were encountered in our study including diabetes mellitus, age-related (senile miosis), uveitis, pseudo-exfoliation syndrome, intra-operative floppy iris syndrome and chronic Pilocarpine use. From the above mentioned causes, diabetes mellitus was the most common cause encountered in 42 eyes (52.5%).

Intra-operative pupil size was measured before dilatation. It ranged from 2-4.5 mm in mechanical dilatation group with mean of 2.75 ± 0.08 mm and in non-mechanical dilatation group; It ranged from 1.5-4 mm with mean of 2.74 ± 0.32 mm before pupil dilatation. P value was 0.924 with insignificant difference. After dilatation, the size of the pupil changed from mean of 2.75 ± 0.08 mm to a mean of 6.00 ± 0.00 mm in the mechanical dilatation group while in the non-mechanical dilatation group the increase in pupil size was from mean of 2.74 ± 0.32 mm to a mean of 4.26 ± 0.48 mm with statistically significant difference between the 2 studied groups with P value < 0.001 .

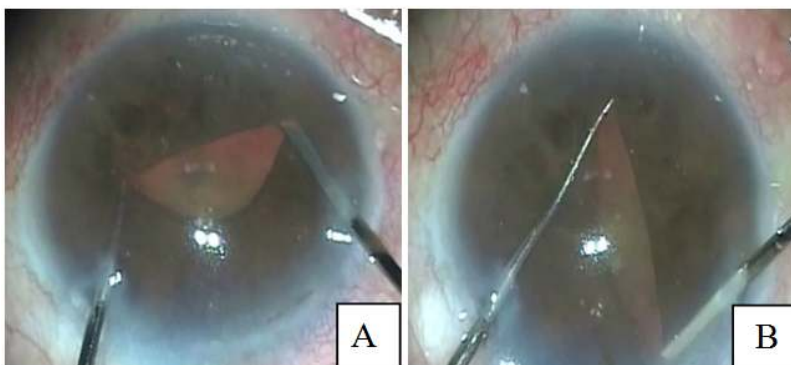


Fig. 1. A, B showing mechanical stretching of the pupil



Fig. 2. (A) showing the platform containing unfolded Oasis ring, (B) showing Oasis ring dilating the pupil and (C) showing removal of Oasis ring at the end of the procedure

Additional intra-operative time for pupil dilatation was calculated and found ranging from 83- 117 seconds with mean of 93.2 ± 11.36 in the mechanical dilatation group while it ranged from 48- 76 seconds with mean of 54.6 ± 9.88 in the non-mechanical dilatation group. Additional corneal incision was needed in cases of non-mechanical group. There was significant difference between the 2 groups regarding additional intra-operative time for pupil dilatation (P value was < 0.001).

No intra-operative difficulties were encountered in the mechanical dilatation group. In the non-mechanical dilatation group during phacoemulsification, there were iris prolapse in 3 eyes (7.5%), minimal bleeding in 4 eyes (10%), iris inclusion by phaco probe in 3 eyes (7.5%) and iris trauma during irrigation aspiration in 2 eyes (5%). Statistically significant difference was found between the 2 studied groups with P value < 0.001 .

1 month post-operative follow-up of the pupil characters showed that Pupils dilated using Oasis ring were central, rounded, reactive with no bruises or tears. In the non-mechanical dilatation group, oval pupil was found in 7 eyes (17.5%) and minute tears were found 5 eyes (12.5%). Regarding post-operative characters of the pupil, statistically significant difference was found between the 2 studied groups with P value < 0.001 .

4. DISCUSSION

The development of surgical techniques in modern ophthalmology is connected with the reduction of surgical trauma. Phacoemulsification in eyes with a narrow pupil not responding to standard pre-operative pharmacologic management is known to be a challenge for any ophthalmic surgeon. During phacoemulsification,

it is necessary to have good trans-pupillary access to the lens [1].

A small pupil may cause damage to the patient's eye by emulsification of the iris or may cause complications such as sphincter tears, intra-operative bleeding, zonular dialysis, posterior capsular tear or nucleus drop. Prolonged surgical time and increased maneuvering may result in post-operative complications such as striate keratopathy, uveitis, secondary glaucoma, irregular pupil, endophthalmitis and cystoid macular edema in addition to floppy, torn, or atrophic iris which result in sub-optimal surgical outcome and an unsatisfied patient [12].

There are many causes of narrow pupil including: Age related, dilator atrophy, pseudoexfoliation, diabetes mellitus, iridoschisis, excessive iris manipulation during surgery and glaucoma patients using long-term miotics. Tamsulosin hydrochloride (Flomax), a systemic α -1 antagonist medication used for benign prostatic hypertrophy, has been shown to produce miosis and poor pupil dilation along with intraoperative floppy-iris syndrome (IFIS) [4,12].

The ability of the pupil to dilate well should be determined in the out-patient clinic during the pre-operative visit. Both topical cycloplegic mydriatics and sympathomimetic agents should be administered to assess dilatation of the pupil. Pharmacological dilatation might break posterior synechiae pre-operatively. Even if adequate pupil dilatation is not achieved by this pre-operative office regimen, it allows the surgeon to plan an intra-operative pupil management strategy [13].

Akman et al documented that bimanual stretching achieved good pupil size 4.9 ± 0.7 mm but the size was usually smaller than that obtained by other systems in their study. Bimanual stretching could be performed in less

than one minute (55 ± 10 seconds) and was thus a time-saving method but could cause micro-ruptures of the sphincter that were functionally insignificant [3]. Similar results were obtained in our study.

Comparable results to ours were obtained by Vasavada who used Healon GV to dilate narrow pupil. A 4.42 ± 0.58 mm pupil was achieved. Iris was traumatized in ten eyes (33%) of his study during sub-incisional cortex removal. Blind manipulations under the pupil increase the chances of catching the iris. Although he had successfully used this technique for small pupil in compromised eyes, he admitted that in certain situations (e.g., inability to perform a capsulorhexis larger than the pupil size, possible hidden small chips of hard nuclei, doubtful cortical cleanup, uncertainty of in-the-bag haptic placement and suspicion of zonular dialysis), pupil widening devices such as flexible iris retractors may be considered [7].

Akman and others considered achieving largest pupil size (5.9 ± 0.6 mm) in their study and maintenance of that size throughout the surgery as main advantages of the PMMA pupil-dilator ring. That device also prevented the iris from being aspirated into the aspiration port, because it acted as a barrier between the iris and the phaco tip. The mean added surgical time for implantation of a PMMA pupil-dilator ring was 176 ± 54 seconds. Because the pupil was not stretched excessively with this ring, the risk of sphincter rupture was small [3].

Akman and his colleagues used iris-retractor hooks in their study which produced a mean pupil size of 5.6 ± 0.6 mm. Being able to adjust pupil size according to the preference of the surgeon was one of the advantages of this technique, in addition pupil size remained constant throughout the surgery. Creating the four stab incisions and inserting and positioning the iris-retractor hooks took approximately five minutes (297 ± 51 seconds). They mentioned that the requirement for four stab incisions and four instruments to be placed in the eye increased the level of risk involved [3].

Chang mentioned in his study that the Malyugin ring was faster and easier to insert and remove than iris retractors and there was no need to make additional corneal paracentesis openings. The proximal scroll of the Malyugin device also provided excellent access to the sub-incisional cortex. The ring maintained a constant 6.0 mm

pupil diameter throughout surgery. Although iris prolapse was still possible, there were no significant intraoperative or postoperative complications despite the fact that 93% of the eyes had moderate to severe IFIS. All eyes achieved a best corrected visual acuity of at least 20/25 [9].

To the best of our knowledge, no previous reports about using Oasis ring are available. Oasis ring in our study resulted in increasing pupil size from a mean of 2.75 ± 0.08 mm to a mean of 6.00 ± 0.00 mm. Insertion of Oasis ring needed additional intra-operative time of 93.2 ± 11.36 to achieve pupil dilatation. No additional corneal incision was needed more than usual. Postoperative pupils during follow up were central, rounded and reactive.

5. CONCLUSION

Pupil dilatation with Oasis ring increases the cost and the intra-operative additional time for pupil dilatation, but it provide stable and sufficiently dilated pupil, which facilitate phacoemulsification steps making them safer and with less complications when compared with non-mechanical methods.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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