Safety and efficacy of phacoemulsification and intraocular lens implantation through a small pupil using flexible iris retractors

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Abstract Background: Cataract is a very common cause of blindness globally. Phacoemulsification and foldable intraocular lens (IOL) implantation is the choice of surgery for cataracts. Some patients who need cataract extraction have eyes with small pupils due to various reasons that makes the procedure difficult and leads to more complications. Flexible iris retractors can be used to retract the pupil during phacoemulsification. We compared the outcomes of phacoemulsification through a small pupil using flexible iris retractor with those of phacoemulsification done through a well dilated pupil. Aim of the study: The aim of this study was to compare results of phacoemulsification through a small pupil using iris retractor versus through a well dilated pupil. Materials and Methods: This was a prospective study and comprised of forty patients (group A) with a maximally dilated pupil size of ≤ 4.00 mm and forty patients (group B) with dilated pupil size of \geq 7.00 mm. Patients were aged between 40 years to 70 years. In group A patients, only viscodilation and flexible iris retractor was used to increase the pupil size. Phacoemulsification was performed by one single experienced surgeon. Technique used was direct chop or stop and chop. In group A patients vacuum and aspiration flow rate was little lowered during phacoemulsification. Patients were examined on day 1 and then at 1st week, 1st and 3rd month. Results: In group A patients, the mean pupil size measured under an operating microscope was 3.2mm to 3.8 mm preoperatively and 5 to 5.5 mm after mechanical stretching by iris retractors. Intraoperatively no major complication was found in both the groups. In group A patients in first day postoperative period, mild corneal edema seen in two cases and mild iritis was seen in 11 cases. In group B patients there were no postoperative complications. One month postoperatively all cases had clear cornea, round pupil and anterior chamber was quiet. Conclusion: Phacoemulsification through a small pupil using flexible iris retractor is safe and clinical outcomes are at par with phacoemulsification through well dilated pupil. Key Words: Phacoemulsification, Small pupil, Iris hooks.

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INTRODUCTION

Cataract is the most common cause of blindness all over the world.¹ Phacoemulsification and foldable intraocular lens (IOL) implantation is the choice of surgery for cataracts.² Some patients who need cataract extraction have eyes with small pupils which is attributed to pseudoexfoliation syndrome, aging, diabetes mellitus or uveitis. A small pupil can hinder visualization leading to small capsulorhexis. There is also a higher risk of complications during phacoemulsification through a small pupil, such as posterior capsular rent and zonulodyalysis, vitreous loss^{3,4} and endothelial cell loss.⁵ More over intraoperative miosis constitutes the foremost risk factor that influences conversion from phacoemulsification to

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extracapsular cataract extraction. Several methods to mechanically stretch small pupils have been described. Flexible iris retractor can be used to retract the pupil during phacoemulisification⁶ and mechanical stretching devices can be inserted to pull the iris sphincter.⁶⁻⁸ There is paucity of published data showing results of phacoemulsification through small pupil using flexible iris retractor. We compared the outcomes of phacoemulsification through a small pupil using flexible iris retractor with those of phacoemulsification done through a well dilated pupil.

MATERIALS AND METHODS

This study was a prospective study done in the department of Ophthalmology at Kamineni Academy of Medical Sciences and Research Centre, Hyderabad over a period of 18 months from April 2016 to September 2017. The study comprised of forty patients (Group A) with a maximally dilated pupil size of ≤ 4 mm and forty patients in Group B with dilated pupil size of \geq 7mm. Patients were aged between 40 years to 70 years. Nuclear sclerosis 2+ were included in this study. Cases with corneal pathology like Fuch's dystropy and traumatic cataracts were excluded from this study. Institutional ethics committee clearance was obtained before the start of the study. A written and informed consent was obtained from all patients after explaining the procedures and associated risk factors. In all cases visual acuity, slit lamp examination, measurement of pupil diameters with calipers at the slit lamp, intraocular pressure (IOP) recording, fundus examination after putting tropicamide (0.8%) and phenylephrine 5 % eye drops and ultrasonic biometry was done. All patients were operated by an experienced surgeon. Phacoemulsification was done in all cases. Preoperatively tropicamide (0.8 %) and phenylephrine (0.5%) and cyclopentolate (1%) eve drops were put every 15 minutes for three times two hours before surgery. Peribulbar block was given with 3 ml of xylocaine (2%) mixed with 150 units / ml of hyaluronidase and 7ml of bupivacaine (0.5%). Topical povidone 5% eve drop was put five minutes before surgery. Patient's eye was draped with a sterile adhesive disposable eye drape and an eyelid speculum was inserted. A 2.8 mm clear corneal, self-sealing incision was made at 12 o'clock position, and the anterior chamber was filled with viscoelastic agent. Viscoelastics sodium hyaluronate was used in hard cataracts (grade IV) and all other types of cataract hydrovpropylmethyl cellulose was used. Then two side-port incisions were made at the 9

o'clock position and 3 0'clock positions. In group A patients, four extra second side-ports at 1 o'clock, 10 o'clock, 5 o'clock and, 7 o' clock positions were performed. Four flexible iris retractors were inserted in extra side ports to mechanically stretch the pupil. In each of the 40 eyes in group A, pupil size was measured horizontally before the initiation of surgery by using a caliper under operating microscope, after the injection of viscoelastic material and mechanical pupil dilation. After pupil dilatation, capsulorhexis of 5 to 5.5 mm size was done. Hydro-dissection was done gently. Phacoemulsification was performed by means of standard stop and chop or direct chop technique. Balanced salt solution (BSS) containing 0.5 ml of 1:1000 preservative free adrenalin was used for the irrigation solution in group A patients. In all patients of group A vacuum and aspiration flow rate was little lowered during phacoemulsification. After phacoemulsification was completed, all cases had an infusion/aspiration of the lens cortex, capsular bag refill with ocular viscoelastics, and implantation of an acrylic foldable IOL. The viscoelastics was then aspirated, IOL was tapped so that viscoelastics which was there behind the IOL came to anterior chamber and left over viscoelastics was again aspirated and the anterior chamber was refilled with BSS. Pupil size at the end of the surgery was recorded. The corneal wound and side port were hydrated with BSS. Pad and bandage was put on the eye ball. Postoperatively patients were put on prednisolone 1% eye drop six times daily and moxifloxacilin 0.5% eye drop four times daily in all cases. Topical steroid was tapered over 6 weeks. Topical antibiotic was stopped after 10 days. Patients were followed on the postoperative day 1, day 7, at the end of one month and 3 months. Postoperatively visual acuity, slit lamp examination was done and IOP was recorded in all patients. Corneal edema was graded^{9,10} as grade 0, if there was no edema, grade l, if it was mild. Grade 2 edema was mild to moderate (visible iris details), grade 3 was moderate to severe (obscuring iris details) and grade 4 was marked (obscuring pupil). Iritis/anterior chamber flare was as graded¹¹ as grade 0, if there were < 5 cells in the anterior chamber and no flare, grade 1+ if there were 6-15 cells and faint flare. In grade 2 +, there were 16-25cells and moderate flare (iris and lens details clear), in grade 3+, there were 26-50 cells and marked flare (iris and lens details hazy), and in grade 4+, there were >50 cells and intense flare (fibrin membrane). All findings were recorded by the operating surgeon.

OBSERVATIONS AND RESULTS



Figure 1: Preoperative image of right eye showing small pupil with mature cataract after instillation of dilating drops.
Figure 2: Intraoperative image of right eye in same patient as above with flexible iris retractor. Small initial capsulorhexis has been done to wash some cortical matter to reduce the intralenticular pressure in a mature intumescent cataract
In statistical analysis the significance level was defined as p< 0.05.</p>

Table 1: Comparison of group A and B					
	Group A	No. of cases	Group B	No. of cases	
	Grade 0	38	Grade 0	40	
Corneal	Grade 1	2	Grade 1	-	
edema	Grade 2	-	Grade 2	-	
	Grade 3	-	Grade 3	-	
	Grade 4	-	Grade 4	-	
	Grade 0	29	Grade 0	40	
Iritis/ anterior	Grade 1	11	Grade 1		
Chamber flare	Grade 2	-	Grade 2	- 1	
	Grade 3	-	Grade 3	-	
	Grade 4	-	Grade 4	- 1	
Sphincter tears	-	6		-	

There were no statistically significant differences in age between the two study groups (p > 0.05). The cause of small pupil was pseudoexfoliation syndrome in 21 (52.5%) cases, senile miosis in 12 (30%) patients, diabetic pupillopathy in 5 (12.5%) patients and old iridocyclitis with posterior synechiae in 2 (5%) patients. In group A patients the mean pupil size measured under an operating microscope was 3.2 mm to 3.8 mm preoperatively, 5.5 to 5.8 mm after viscoelastic and mechanical pupil dilatation and 4.4 to 4.7 mm after the end of surgical procedure. On the other hand, in group B patients, the mean pupil size measured under an operating microscope was 7.2 mm after the instillation of mydriatic drops, Very small iris sphincter ruptures were present in six eyes of group A patients during pupillary manipulation (p>0.05). All 80 eyes had round and symmetric pupils on the first postoperative day. In group A grade 1 corneal edema was present in two cases. Eleven patients had grade 1+ iritis. In group B patients all patients had clear cornea and anterior chamber was quiet. IOP was less than 21 mm of Hg in all group A and group B patients. One month postoperatively the pupils were round and reactive to light, anterior chamber was quiet.

corneas were clear in all cases of group A and group B patients. Visual acuity was 6/12 or better in all eyes studied at the end of one month.

DISCUSSION

Phacoemulsification with foldable IOL implantation is the choice of surgery for cataracts because of less postoperative astigmatism and early visual rehabilitation. Sufficient pupillary dilation before proceeding to cataract extraction is extremely important for a successful phacoemulsification surgery. Some patients with cataract requiring phacoemulsification do not have well-dilated eyes despite instilling topical mydriatic agents repeatedly. The main causes include pseudoexfoliation syndrome, iris sphincter sclerosis due to aging, uveitis with posterior synechiae and diabetes mellitus. Patients presenting with a small pupil at the time of cataract surgery can cause a major clinical dilemma, since the surgeon must decide whether to insert pupillary dilating device (eg. iris hooks or iris rings) in order to perform an uncomplicated operation or not. Sometimes pupillary dilation can be injection achieved by the of viscoelastics (viscomydriasis). Healon 5 (AMO, Santa Ana, CA), a high molecular weight sodium hvaluronate viscoelastic, is uniquely capable of dilating and maintaining a wide pupil. However, performing a cataract surgery through a poorly dilated pupil can be challenging. Since visualization of the cataract can be compromised and can lead to insufficient capsulorhexis. However, even if a satisfactory capsulorhexis is made, attempting to operate through an inadequately dilated pupil can result in iris damage, ruptured posterior capsule, vitreous loss, and dropped nucleus. The vast majority of cataract surgeons usually decide to mechanically dilate the pupil during surgery if it is still miotic after installation of dilating eve drops. Various techniques and instruments can be implemented for enlarging a poorly dilating pupil. The

most common devices and technique are the iris-retractor or hooks, pupil dilator rings,¹²¹ and the bimanual stretching technique. The first three methods produce a mean pupil size of 5.4 mm which remains constant throughout the surgery especially with pupil-dilator rings preventing the iris from being aspirated into the aspiration port, thus acting as a barrier between the iris and the phacoemulsification tip. Despite the fact that these methods enlarge the pupil adequately, some are expensive (Malyaugin ring).Malyaugin ring advance is an injectable ring developed by Dr Boris Malyugin of Moscow and distributed by MST (Redmond, WA). The closed ring is injected through a small incision and its four scrolls capture and retract the pupil border, maintaining an adequate opening until the device is removed at the end of the procedure. Any surgical technique to dilate a miotic pupil must be safe, less expensive and should minimize intraoperative and postoperative complications. А sufficient pupil size for uncomplicated phacoemulsification depends on the surgeon's expertise, the nature of cataract, and the anatomy of the anterior chamber. In our study, all patients with small pupils were operated on by single experienced surgeon who used flexible iris retractors to dilate the pupil. To insert flexible iris retractors is little time consuming but these are very effective in maintaining an enlarged and stable pupil during phacoemulsification and also is less expensive. We compared the results of phacoemulsification in patients with small versus well-dilated pupils. There was no statistically significant difference regarding intra or postoperative complications. Little less vacuum and aspiration flow rate was used during phacoemulsification. Flexible iris retractors can cause small sphincter tears which occurred in only six (15%) patients. The esthetic and functional effects of these sphincter tears were not significant at the end of one month. Grade 1 corneal edema occurred in two cases (5%) and is attributed to iritis. Iritis occurred in 11 (27.5%) cases due to iris manipulation. At the end of one month corneas were clear and anterior chamber was quiet. Limitation of study was specular microscope was not used to count the endothelial cell loss postoperatively. In our study, all patients had nuclear sclerosis 2+ or above. It would be useful for future studies to compare the postoperative findings related to cataract density.

CONCLUSION

A poorly dilated pupil can impede visualization, making phacoemulsification more difficult and can potentially cause more complications leading to poorer visual outcomes. Phacoemulsification using flexible iris retractors in poorly dilated pupil is safe and exhibits same clinical outcome as through well dilated pupils.

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