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Study of manual small incision cataract surgery (MSICS) for ideal size of central curvilinear capsulorhexis(CCC): 6mm or larger

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Abstract

In India MSICS Is still preferred technique in volume surgery institutes. Now whether MSICS is done as a learning step to phacoemulsification, due to unavailability of machine or due to lack of skill; advantages of Cental Curvilinear Capsulorhexis cannot be ignored though visual outcome may be the same. It not only acts as a lifeline in PC rent but it secures the IOL in the bag also. But simultaneously delivery of the nucleus through CCC is bit tricky. So it's not only mandatory for phacoemulsification, for MSICS surgeon it makes the learning curve easier and uplifts the quality of MSICS surgery too. In this study comparative analysis has been done between two groups where in group A CCC in the range of 5.5 mm to 6mm with radial cuts was made and in group B CCC more than 6mm(in the range of 6mm to 6.5mm)was made. It was found that in patients where CCC less than 6mm was made, delivery of nucleus was not smooth and problems like zonulolysis, PC rent, bag detachment were noticed after nucleus delivery. In cases where bigger CCC 6mm or more was made delivery of nucleus was easy and complications were less. So to conclude always aim for CCC more than 6 mm in MSICS. In bigger CCC even 6mm optic/12.5mm PMMA lens can be implanted in the bag without stretching and decentration.

Keywords: Central Curvilinear Capsulorhexis, Capsulotomy, Decentration, PCO, Zonulolysis

Introduction

National programme for control of blindness was launched in 1976 with a goal to reduce prevalence from 1.4% to 0.3% in 2020. In 2001-2002 prevalence was 1.1%. As per rapid survey of avoidable blindness 2006-2007 prevalence was 1%.(1) Now cataract contributes to 62.6% to this blindness. Though supremacy of phacoemulsification over MSICS is beyond doubt in terms of astigmatism, problems like nucleus drop are also of major concern. Endothelial cell loss is at par. Apart from this, major reason for doing MSICS in our scenario is that majority of the patient being from low socioeconomic group can't afford the cost of surgery. Lack of skill is another reason. Then also the learning curve to phacoemulsification becomes easier if we master MSICS.

Now there can be many ways to open the capsule like can- opener technique, envelope or CCC. In MSICS we can very well use envelope technique or canopener but there are many advantages of CCC. So transition from can opener capsulotomy to CCC is not only mandatory for phacoemulsification but because of added benefits it's making MSICS even a higher quality surgery.(2)

According to Sanjib Kr Chaudhary et.al comparative study between CCC and envelope technique was done in MSICS and he found better outcome with CCC in terms of visual aquity, IOL centration and PCO formation.(3)

Capsulorhexis also known as continuous curvilinear capsulorhexis (CCC), is a technique pioneered by Howard Gimbel in 1985(4) and later by Neuhann in 1987.(5) For perfect circular capsulorhexis we are using shearing and tearing forces to counterbalance centrifugal forces exerted by elasticity of capsule and zonules. After initial linear cut tangential force is applied continuously otherwise there is tendency of CCC to run in periphery. We all are aware about basic advantages of CCC.(6)

- Radial tears has a tendency to run in periphery and towards posterior capsule. It is limited by a circular opening.
- It's a strong capsular rim that resists tearing even when stretched during cortex removal and lens implantation.
- Intraoperative stress on zonules is minimal and evenly distributed at equator.
- It facilitates hydrodissection, endolenticular phacoemulsification & capsule polishing.
- Safe lens implantation in adults and children
- Intact CCC is always a lifeline in PC rents.
- It not only acts as a lifeline in PC rent but it secures the IOL in the bag also.

Criteria for Ideal CCC

It should be central circular but to avail it's benefits and at the same time taking into consideration safety and making the surgery eventless, size of the CCC is equally important. We should look for pros and cons of smaller sized CCC versus bigger CCC. Ideally overlap of 0.25 mm to 0.5 mm is required to prevent migration of lens epithelial cells. An oversized capsulorrhexis will prevent overlap; a too-small one will predispose the eye to anterior capsular contraction, eventual phimosis, anterior movement of the foldable lens, and late myopic

shift. When we are doing phacoemulsification and rather more when we are doing MSICS to avoid complications and simultaneously to avail the benefits of CCC, size of CCC plays an important role.

According to Krag S et.al. posterior capsule can withstand a pressure of 59±10 mm of Hg.[7,8] According to Venkatesh et. al. in hydroprolapse method hydrodissection is done at 3 and 9 o'clock, eye ball should be kept soft by removing excess of viscoelastic which prevents prolapse of nucleus.[9] We can do phacoemulsification comfortably through 5.5 mm CCC but it's bit tricky to do MSICS through this depending upon the hardness of cataract. In a study done by Vasavada et.al in cadaveric eyes, size of CCC varied from 4mm. to 6.5mm and they reported more complications when size of CCC was less than 5.5 mm.[10] Sometimes even after applying radial cuts delivery is not smooth. Improper hydrodissection or corticocapsular adhesions may be one of the reason but intact rim over nucleus definitely adds on to this.

Materials and Methods

This study was performed in RKDF medical college hospital and research centre Bhopal from April 2014 to June 2016. Total 120 cases were selected from April 2014 to December 2014 and follow was done for 1 year and 6 months. Written consent was taken from the patient.

Inclusion criteria: All the patients diagnosed as senile cataract with nuclear sclerosis NS ++ and NS +++ were included. Age group was 40 to 70 years including both Sexes.

Exclusion criteria: Diabetic patients, small pupil, patients with history of iridocyclitis in past, history of previous surgery, traumatic cataract, subluxated lens, corneal degenerations and dystrophies, patients with pterygium, glaucoma patients and patients operated under guarded visual prognosis.

Aim of our study was to compare the safety of procedure with bigger CCC and disadvantages of bigger CCC.

In Group A cases with CCC 5.5 to 6mm were included. Those cases where after hydro dissection and delineation nucleus was not coming easily we gave radial cuts and in group B all cases with CCC in the range of 6 mm. to 6.5 mm were included. CCC was measured by a blunt iris repositor with marking. Marker for toric IOL was used. In all cases PMMA lenses with 6mm optic/12.5mm were implanted. Follow up was done on 1st postoperative day, 3rd postoperative day, 7th postoperative day, after 1 month, after 6 months, 1 year after surgery and $1^{1/2}$ year after surgery.

Parameters Studied: We have evaluated operative procedure under following heads**:**

1 Nucleus delivery – popped up easily or with difficulty
2 Size of CCC less than 6 mm or more than 6 mm
3 Radial cuts applied or not
4 Zonulolysis or PC rent after nucleus delivery or after cortical wash
5 Vitreous loss
6 IOL implanted in the bag or over CCC
7 IOL decentration or tilt
8 Postoperative vision in follow ups and significant difference in astigmatism
9 Corneal oedema
10 Postoperative iridocyclitis
11 IOP rise
12 PCO formation
13 Optic covering by CCC

Statistical Analysis: In present study comparative groups matching was done and all data were entered in excel sheet. Statistical analysis was done by using SPSS 16, test of significant applied whenever applicable. P value <.05 considered to be significant.

Table 1: Profile of patients (N=120)

Age Group	No. of Patients
40-50	11
51-60	48
61-70	61
Sex	
Male	64
Female	56
Eye	
RE	69
LE	51
Nuclear Sclerosis	
NS ++	57 Group A – 30 Group B - 27
NS+++	63 Group A - 30 Group B - 33

Preoperative Evaluation: In all the patients, detailed clinical history recorded, general physical examination done to rule out diabetic patients and physician consent taken for surgery under local anaesthesia. In local examination all patients were examined for visual acuity by Snellen's chart unaided, with pin hole visual acuity and best corrected visual acuity, refractive error by retinoscopy and refraction, intraocular pressure by applanation tonometer, syringing for patency of the lacrimal drainage system, keratometry and biometry to calculate the IOL power, detailed slit lamp examination to check grading of nuclear sclerosis, to rule out chronic iridocyclitis or small pupil, exfoliation, fundus examination done with indirect ophthalmoscopy and with slit lamp biomicroscopy. Patients were randomly divided into two groups. In both the groups patient underwent MSICS and CCC was made. In Group A: Subjects underwent MSICS with CCC 6 mm or less(range5.5mm -6mm). In Group B: Subjects underwent MSICS with CCC more than 6 mm (range6mm-6.5mm).

Operative Procedure: Pupil dilated using 1% tropicamide with 2.5% phenylephrine eye drops. Peribulbar anesthesia was given. Sclerocorneal tunnel was made. Incision size was between 6mm to 6.5 mm. Blue due was used. Methylcellulose was used as viscoelastic. In both the groups CCC was made with bent neddle on insulin syringe. In Group A we included patients with rhexis 6 mm or less (In the range of 5.5 to 6mm). After hydrodissection and hydrodelineation if nucleus was not coming out easily radial cuts were given and in Group B we kept all the patients with CCC more than 6mm. In all the patients rigid PMMA lens 6mm optic was implanted. CCC size was measured by a iris repositor which was marked and also a rough estimate by the size of the IOL optic. If it was covered by CCC it means CCC was less than 6 mm. Then we observed that in which group nucleus delivery was difficult or popped up easily, nucleus came out but zonulolysis was noticed, pc rent noticed at the time of cortical wash, vitreous loss, in how many cases we implanted the lens over rim and in how many cases we implanted the lens in the bag, in how many cases IOL optic was covered by CCC rim. Total surgical time in Group A and Group B was noted.

Follow-up examination was done on the 1st postoperative day, 3rd post op day, 1st week, 4th week, 6months, 1year postoperatively and 1and half year postoperatively. Details were recorded by filling proforma of the patient.

Table 2: Showing intraoperative difficulties

S.N.	Types of intraoperative difficulties	Group A	Group B	Chi square & P value
1	Delivery of nucleus	Easy in 40 patients	Easy in 60 patients	21.660 **P<0.0001(HS)**
2	Zonulolysis after nucleus delivery	3	nil	P=0.2422(NS)
3	PC rent after nucleus delivery	2	nil	
4	PC rent after cortical wash	Nil	1pt	
5	Iris prolapsed	Nil	nil	
6	Vitreous loss	2	nil	
7	IOL implanted in the bag	40	59	
8	IOL implanted in the bag with radial cuts	15	nil	
9	IOL implanted over CCC	5	1	

Table 3: Showing postoperative complications

Post-operative complication	1st post-operative day		3rd post operative day		7th post operative day		1 Month after surgery		After 6 Month		After 1Year		After 1 1/2 Year	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Corneal Oedema	8pts	2pts	2pts	Nil	nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Post Operative Iritis	2pts	Nil	Nil	Nil	Nil	nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Iris prolapse and wound leakage	Nil	Nil	nil	Nil	nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
IOP rise	2pts	Nil	2pts	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
IOL decentartion	3pts	nil	nil	Nil	3pts	Nil	3pts	Nil	4pts	2pts	4pts	2pts	4pts	2pts
PCO	Nil	Nil	nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	3pts	2pts
Anterior capsular contraction	Nil	Nil	nil	Nil	nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Abbreviations: patients –Pts., A - Group A, B – Group B, MSICS – Manual small incision cataract surgery, IOL – Intraocular lens, CCC – Continuous Curvilinear capsulorhexis.

Results

A total of 120 eyes of 120 patients undergoing MSICS were studied. In all the patients CCC was made. The patients were equally divided into two groups. In Group A there were 60 patients and size of CCC was less than 6mm (in the range of 5.5 to 6mm). In Group B also there were 60 patients and size of CCC was more than 6mm (in the range of 6-6.5mm). In Group A there were 30 patients with nuclear sclerosis NS ++ and 30 patients with NS +++. In Group B there were 27 patients with NS ++ and 33 patients with NS +++. Difference among two groups was not found statistically significant.

Mean age of the subjects in years ± SD in both the groups were 55.075 ± 6.732. No statistically significant difference was found in the distribution of age or gender between two groups. Mean surgical time (± SD)

in group A was 1020 sec. and 908 sec. in group B which was found to be statistically significant.

We noticed significant difference in ease of nucleus delivery between two groups. In Group B nucleus popped up easily after hydrodissection and hydrodelineation. In Group A in 20 cases nucleus delivery was not easy so we gave radial cuts. In 15 cases we were able to deliver the nucleus without any complication and in 3 cases we noticed zonulolysis. As it was not more than 2 clock hours position we were able to manage and after cortical wash we implanted the lens on the rim. In 2 patients we noticed PC rent after nucleus delivery, though difference was noticed but it was not statistically significant. As rent was not big and after anterior chamber vitrectomy we implanted the lens on the rim. In group B we noticed PC rent after cortical wash in 1 patient and we implanted the lens on the rim and there was no vitreous loss. So out of 60 cases we implanted lens over the bag in 59 patients.

Corneal oedema was found in both the groups on 1st postoperative day and it was not statistically significant. It resolved on 3rd day in Group A except 2 cases who had vitreous loss and in these patients also odema resolved on 7th post operative day.

IOP was increased in 2 patients in Group A, 22 mm of Hg and 24 mm of Hg and probable reason was mild iritis following vitreous loss. Apart from cycloplegics topical timolol dorzolamide combination was given, Iritis recovered in next follow up and IOP in a week's time. At the end of one month best corrected visual acuity was 6/12 on snellen's chart in two patients with vitreous loss.

IOL decentration was noticed in Group A in 3 patients on 1st post-operative day as it was in perfect pupillary plane, so no intervention was required. In one patient it was noticed late at 6 months and no significant difference was observed in terms of cylindrical error. In group B It was noticed in 2 patients at 6 months and no tilt was noticed. No statistically significant difference in average cylindrical error and visual acuity was noted among two groups.

Discussion

Superiority of phacoemulsification over MSICS is beyond doubt and is a established fact but still MSICS is preffered method in volume surgery institutes or due to cost of machine or lack of skill. MSICS is also developed as a learning step to phacoemulsification. As incision size is usually more than 6mm, foldable implant is not contraindicated though rigid implant can work equally well. As capsulotomy is an important step and MSICS can be done through can- opener or envelop capsulotomy. Though CCC in MSICS is not mandatory as in phacoemulsification but we all know the advantages of CCC. But at the same time delivery of nucleus is bit tricky.

In our study in Group A CCC size was 5.5 mm to 6mm. Out of 60 cases in 20 cases we found difficulty in delivering nucleus after hydrodissection. In remaining 40 cases it popped up easily after hydrodissection and delineation. In 20 cases we gave radial cuts(2-3mm insize) diagonally opposite to each other and in 15 patients we were able to take out the nucleus safely and surgery was eventless . We implanted the lens in the bag. Out of 5 patients in 3 patients we noticed zonulolysis after nucleus delivery less than 2 clock hours and IOL was implanted on anterior capsule safely and in 2 patients we noticed PC rent after nucleus delivery. Again lens was implanted on capsular rim safely. Post operative vision was 6/9 in 3 cases and 6/12 in two case respectively.

As per CME series 8 Dr. KPS Malik. et. al, despite free rotation it's difficult to prolapse nucleus from lower quadrant with smaller CCC. They also recommend CCC of at least 6mm, in MSICS. They used viscoelastic which pressed lower rim and hooked the upper part of nucleus.[11]

In our study also nucleus delivery was not easy in Group A in comparison to Group B Where CCC was bigger and radial cuts were not required so dynamics of bag were retained in a better manner in comparison with CCC with radial cuts. CCC Of 5.5 mm without radial cuts is always best as it covers the 6mm optic very well and provides the better stability of IOL but at the same time we noticed more cases of zonulolysis and PC rent, though difference between 2 Groups is not statistically significant but we should always aim towards safe surgery.

In group B with CCC more than 6 mm nucleus delivery was easy, no zonulolysis was noticed after nucleus delivery and no radial cuts given. Only in 1 patient PC rent was noticed which was due to positive pressure during cortical wash.

Postoperative iridocyclitis was noticed in 2 patients in Group A on 1st postoperative day. It was mild which recovered on 3rd postoperative day. Probable cause for iridocyclitis was vitreous loss, improper wash of viscoelastic or intracameral pilocarpine. IOP rise was borderline which was restored in a week. Corneal oedema was noticed in more number of cases in Group A in comparison to group B which could be explained due to longer surgical time, difficulty in nucleus delivery or vitreous loss.

In a study done by Oner et. al., they noticed that PCO formation is more with envelope technique in comparison to CCC. With CCC, Ideally overlap of 0.25 to 0.5 mm. is required over optic of IOL to prevent migration of epithelial cells which limits PCO formation. In a study by Ravalico G. et. al. They found if size of CCC is smaller than IOL optic, PCO formation is less.[13] In our study rate of PCO formation was found almost same and the difference is not statistically significant although in Group B optic was not covered by CCC due to larger CCC .The most likely reason for this is cleaning of anterior capsular rim.

IOL decentration is a major point of concern. In Group A On 1st postoperative day IOL decentration was noticed in 3 pts., though no intervention was required as it was in pupillary plane. Probable cause of decentration was zonulolysis and in 1 more case it was noticed late and probable cause was bag contraction. In group B also decentration was noticed late which could be due to bag contraction. According to Oner et. al. highest decentration was noticed with envelope technique. According to him CCC with one radial cut may not be ideal but can give satisfactory results. Use of 6.5 mm optic or hydrophobic 3 piece foldable can be used after completion of phacoemulsification.(12)

No anterior bulging of IOL and anterior fibrosis was noticed. No significant difference was found in cylindrical correction prescribed between two groups. So CCC bigger than 6mm should be aimed for MSICS which is safe and can be tried in all types of cases.

Conclusion

We all know the advantages of Phacoemulsification but MSICS is still preferred for variety of reasons and always helpful in conversion process. Apart from the fact that MSICS is done as a learning step, in order to make it more qualitative surgery CCC is beneficial. Looking into safety and from view point of complications, it is recommended that CCC more than 6mm should be made and IOL of 6 mm optic can very easily be implanted. Though it doesn't cover IOL rim, stability of Iol in bag is better than CCC with radial cuts. Even CCC with radial cuts is better than envelope technique as per various studies. We didn't notice significant difference in PCO formation as polishing was done but nucleus delivery was easy and smooth; PC rent and zonulolysis was less.

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