

# Visual Outcome and Major Surgical Complications of Phacoemulsification versus Manual Small Incision Cataract Surgery Performed by Resident Doctors at a Regional Institute of Ophthalmology.

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## ABSTRACT

**Background:** Introduction: Cataract is the most frequently performed surgery in the world. The beginner cataract surgeon at our institute is first trained in extra capsular cataract extraction followed by training in manual small incision cataract surgery. Once trained in these two surgical arts, the surgeon is then step wise graduated to doing phacoemulsification. We designed a study to compare the major surgical complications and visual outcome of Phacoemulsification versus MSICS performed by resident doctors at our centre. Aim: The aim of the study was to compare the visual outcome and major surgical complications of Phacoemulsification versus Manual Small Incision Cataract Surgery (MSICS) performed by resident doctors at our Western Regional Institute of Ophthalmology. **Methods:** 253 eyes of 203 patients with visually significant cataract presenting to our outpatient department wer enrolled. The study was carried out at our Regional Institute of Ophthalmology. The study design is a prospective, non-randomized cohort study. Informed consent for cataract surgery was taken from every patient. The data of consecutive resident phacoemulsification and manual small incision cataract surgeries done from December 2017 to February 2018 was analyzed. Phacoemulsification was done by post Master of Surgery JR4. MSICS was done by JR3 and JR2. **Results:** Both the surgeries in all the three resident groups had good visual outcome. The rate of major surgical complications was 3.70%for JR4 performing phacoemulsification,2.6%and 5.74% for JR3 and JR2 respectively performing MSICS. The overall major surgical complication rate for MSICS was 4.52%. **Conclusion:** We conclude that Phacoemulsification and MSICS can be taught to resident doctors with good visual results and a comparable rate of major surgical complications. The beginner resident surgeon graduates comfortably from MSICS to phacoemulsification with low complication rates and good visual results.

**Keywords:** Phacoemulsification, MSICS, Resident surgeons, Visual outcome, Major surgical complications.

## INTRODUCTION

Cataract surgery is the most frequently performed surgery in the world. The surgery promises vision to the large number of patients affected by the opacification of the crystalline lens. The surgery has great visual outcomes but poses a learning curve for the beginner surgeons. Phacoemulsification is a state of the art cataract surgery. Manual Small Incision Cataract surgery (MSICS) still has a place in the surgical armamentarium as a learning step towards phacoemulsification and also as an independent cost-effective sutureless surgery.

The beginner cataract surgeon at our institute is first trained in extra capsular cataract extraction followed

by training in manual small incision cataract surgery. Once trained in these two surgical arts, the surgeon is then step wise graduated to doing phacoemulsification.

We designed a study to compare the major surgical complications and visual outcome of Phacoemulsification versus MSICS performed by resident doctors at our centre.

### Aim

The aim of the study was to compare the visual outcome and major surgical complications of Phacoemulsification versus Manual Small Incision Cataract Surgery (MSICS) performed by resident doctors at our Western Regional Institute of Ophthalmology.

## MATERIALS AND METHODS

253 eyes of 203 patients with visually significant cataract presenting to our outpatient department wer

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enrolled. The study was carried out at our Regional Institute of Ophthalmology. The study design is a prospective, non-randomized cohort study. Informed consent for cataract surgery was taken from every patient. The data of consecutive resident phacoemulsification and manual small incision cataract surgeries done from December 2017 to February 2018 was analyzed. The pre-operative, operative and post-operative data was recorded. The patients were done by Junior Residents 2/3/4 under the guidance of one Assistant/Associate professor. Junior residents one were allotted extra capsular cataract extraction (ECCE) and have not been included in the study. Pre operatively each patient was subjected to a complete anterior segment examination, posterior segment examination, intraocular lens powering and intraocular pressure measurement. Blood pressure was measured and routine blood/ urine investigations were done. Patients with uncontrolled diabetes, uncontrolled hypertension and active infection anywhere in the body were excluded from the study. High risk patients with zonular weakness, posterior polar cataracts, corneal dystrophy or pathology, unioocular patients, post uveitic cataracts, pseudoexfoliation syndrome, patients younger than 35 years, patients requiring general anesthesia, traumatic cataracts, white cataracts and nuclear sclerosis grade 4 and above were excluded from the study. JR2 and JR3 were instructed to observe at least 30 cases of MSICS and be first assistant to 30 cases of MSICS. Thereafter they were allotted MSICS. Phacoemulsification surgeries were assigned to post MS (Master of Surgery) fourth year residents after having observed and been first assistant to at least 30 phacoemulsification surgeries. The surgeries were done under local anesthesia under the guidance of one Assistant/ Associate Professor. The intra-operative complications including the operative step involved were documented. Postoperatively visual acuity and complete anterior and posterior segment examination were documented. Major surgical complications were defined as 1) Posterior capsular rupture or zonulodialysis with vitreous loss with successful Intra Ocular Lens (IOL) implantation. 2) Suprachoroidal hemorrhage. 3) New Vitreous Hemorrhage (VH)/retinal detachment (RD)/ Endophthalmitis within 90 days of surgery. 4) Any complication requiring reoperation within 90 days of surgery including a) Vitreous loss with inability to implant IOL. b) Nucleus drop. c) IOL drop. d) Others. Statistical analysis was performed using the chi square test.  $p < 0.05$  was taken as significant.

### RESULTS

During the three month period 253 Phacoemulsification and MSICS surgeries were performed by residents at our Regional Institute of Ophthalmology.

[Table 1] shows the distribution of cases among the surgeon groups. 21.34% of patients were done by JR4, 30.43% by JR3 and 48.22% by JR2. Greater number of surgeries were done by JR2 reflecting the greater number of JR2 students (MS and Diploma) as compared to JR3 (only MS students) and JR4 (post MS students). 21.34% phacoemulsification surgeries were performed and 78.66% MSICS were done.

[Table 2] shows the pre-operative and post-operative best corrected visual acuity in Phacoemulsification and MSICS groups. 94.44% of patients in JR4 group had BCVA 6/6 to 6/12. Overall 96.10% patients in JR3 group (MSICS) and 97.54% patients in JR2 group (MSICS) had BCVA 6/6 to 6/12.

[Table 3] shows that 3.70% of Phacoemulsification cases and 4.52% of MSICS patients had major surgical complications. P value is more than 0.05 thus the surgical technique in our study did not significantly appear to affect the major surgical complication rate (percentage).

[Table 4] shows the rate of major surgical complications as per the surgeon group. The rate of major surgical complications was 3.70 % for JR4, 2.60% for JR3 and 5.74% for JR2. The p value comparing the three surgeon groups amongst themselves was more than 0.05. Though the major surgical complication rate was higher for JR2, the surgeon group did not appear to be statistically significant in affecting the major surgical complication rate.

[Table 5] shows the factors associated with major surgical complications including age, gender, nuclear sclerosis grade, surgeon and type of surgery. p value is not significant for age, gender, type of cataract, surgeon and type of surgery comparisons.

[Table 6] shows the comparison of major surgical complications in phacoemulsification and MSICS patients. The rate of vitreous loss for Phacoemulsification surgeries was 3.70%. 1.35% of patients in the phacoemulsification group had vitreous loss with successful IOL implantation. A same percent (1.35%) had vitreous loss requiring subsequent vitrectomy with secondary IOL implantation. In the MSICS group 3.5% of patients had vitreous loss with successful IOL implantation while 1% had vitreous loss with secondary IOL implantation. Overall rate of vitreous loss in the MSICS group was 4.5%.

**Table 1: Distribution of cases among the surgeon groups.**

Surgeon	Number of cases n(%)
JR4	54 (21.34)
JR3	77 (30.43)
JR2	122 (48.22)
Total	253 (100)

[Table 7] shows the surgical step at which vitreous loss was documented for the surgeries. In the phacoemulsification group vitreous loss was documented in one patient at the time of emulsifying

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the last nuclear piece and during cortex removal in another patient. In the MSICS group three cases had zonulodialysis and vitreous loss during nucleus

prolapse .One case had vitreous loss during nucleus extraction while five cases documented vitreous loss during the cortex removal step.

**Table 2: BCVA in Phaco and MSICS Group**

Phaco	MSICS					
	JR4	JR3		JR2		
BCVA	Pre-operative	Post-operative	Pre-operative	Post-operative	Pre-operative	Post-operative
6/6-6/12	-	51(94.44)	-	74 (96.10)	-	119 (97.54)
<6/12-6/60	19(35.19)	2 (3.70)	21(27.27)	2 (2.60)	43 (35.24)	7 (5.74)
<6/60	35(64.81)	1 (1.85)	56(72.72)	1 (1.30)	79(64.75)	2(1.64)
Total	54(21.34)	54(21.34)	77(30.43)	77 (30.43)	122(48.22)	122(48.22)

**Table 3: Rate of Major surgical complications as per the surgical technique used.**

Technique	Surgeries without major surgical complications n (%)	Surgeries with major surgical complications n (%)	Total n (%)
Phaco	52 (96.30)	2(3.70)	54(21.34)
MSICS	190 (95.48)	9 (4.52)	199(78.66)
Total	242 (95.65)	11 (4.35)	253 (100)

Chi square statistic is 0.0685. P value 0.79 .The result is not significant at p <0.05 for Phaco versus MSICS complication rate.

**Table 4: Rate of major surgical complications as per the surgeon group.**

Surgeon	Surgeries without complications n (%)	Surgeries with complications n (%)	Total n(%)
JR4	52 (96.30)	2 (3.70)	54 (21.34)
JR3	75 (97.40)	2 (2.60)	77 (30.43)
JR2	115(94.26)	7(5.74)	122 (48.22)

p value is 0.72 comparing JR4 versus JR3 . p value is 0.57 comparing JR4 versus JR2. p value is 0.29 comparing JR3 vs JR2 rate of major surgical complications.

**Table 5: Factors associated with major surgical complications**

Variable	Cases without major surgical complications	Cases with major Surgical complications	Total	P value
Age				
<=60	114	5	119	0.91
>60	128	6	134	
Gender				
Male	132	4	136	0.38
Female	110	7	117	
Nuclear sclerosis				
NS1+to	45	2	47	0.97
NS2+				
NS2+to NS3+	197	9	206	
Surgeon				
Jr4	52	2	54	0.72
Jr3	75	2	77	
Jr2	115	7	122	
Type of Surgery				
Phaco	52	2	54	0.79
MSICS	190	9	199	

**Table 6: Comparison of Major Surgical Complications in Phaco and MSICS patients.**

Complication	Phaco n	MSICS n	Overall n
Posterior capsular rupture or Zonulodialysis with vitreous loss with succesful IOL implantation	1	7	8
Suprachoroidal Hemorrhage	-	-	-
New VH/RD/Endophthalmitis within 90 days of surgery	-	-	-
Any complication requiring reoperation within 90 days of surgery			
a)Vitreous loss with inability to implant IOL	1	2	3
b)Nucleus drop	-	-	-
c)IOL drop	-	-	-
d)Others	-	-	-
Total	2	7	11

**Table 7: Surgical step at which vitreous loss was documented for the surgeries.**

Surgical Step (Phaco)	Phaco		MSICS		Total (MSICS)
	JR4	Surgica 1 Step (MSICS)	JR3	JR2	
Nucleus emulsification (early steps)	-	Nucleus prolapse	1(50)	2 (28.57)	3 (33.33)
Nucleus emulsification (last piece)	1 (50)	Nucleus extraction	-	1 (14.29)	1 (11.11)
Cortex Removal I/A	1 (50)	Cortex removal I/A	1(50)	4 (57.14)	5 (55.56)
IOL Implantation	-	IOL implantation	-	-	
Other steps	-		-	-	
Total	2 (100)		2 (22.22)	7 (77.8)	9 (100)

I/A=Irrigation/Aspiration

## DISCUSSION

The current armamentarium of cataract surgeries available to the beginner/ learning cataract surgeon ranges from the classic Extra Capsular Cataract Extraction (ECCE) to Manual Small Incision

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Cataract Surgery (MSICS) to phacoemulsification. The current study reports Phacoemulsification and MSICS done by resident doctors with good visual results in western India. 94.44% of patients in the phacoemulsification group and 96.98% patients in the MSICS group had BCVA 6/6 to 6/12 postoperatively.

The rate of major surgical complications in the phacoemulsification group was 3.70% while it was 4.52% in the MSICS group. Rate of major surgical complications drops from 5.74% in the JR2 group to 2.6% in the JR3 group showing an improvement in the learning curve with experience. The percentage of complications is low in the phacoemulsification group showing the gradual progression of the learning surgeon from MSICS to phacoemulsification comfortably.

The steps at which major surgical complications occurred have been documented thus aiding the supervising consultant to be more careful during those steps of the learning surgeries.

The study also highlights the age, gender and grade of cataract of the patients enrolled for the study in our region.

To the best of our knowledge this is the first study in western India that compares the outcomes of MSICS versus Phacoemulsification in beginner (resident) surgeons.

Our previous study compared the visual outcome and major surgical complications of ECCE versus MSICS in resident cataract surgeries.<sup>[1]</sup>

We have come across only one other study comparing phacoemulsification versus MSICS in resident surgeries. Haripriya et al report four surgeon groups i.e. staff, fellows, Residents, visiting trainees.<sup>[2]</sup> Surgical distribution was 26% phacoemulsification, 67% MSICS and 7% ECCE. The overall complication rate was 1.11% for phacoemulsification, 1.01% for MSICS and 2.6% for ECCE. The intraoperative complication rate as per surgeon group was 0.79% for staff, 1.19% for fellows, 2.06% for residents and 5% for visiting trainees.

A number of studies reporting visual outcomes and complications of resident operated phacoemulsification cases have been documented.

Meeks et al reported a 2.5% complication rate with phacoemulsification cataract surgery performed by beginner resident primary surgeon and 4.1% complication rate with ECCE.<sup>[3]</sup> They concluded that phacoemulsification cataract surgery could be taught safely and effectively to residents with no cataract surgery experience as primary surgeon.

Thomas et al reported the visual outcome and complications of resident operated learning phacoemulsification cases. A best corrected visual acuity of 6/12 or better was achieved in 94.8% of eyes at 6 weeks of follow-up. A 10% overall incidence of vitreous loss was documented.<sup>[4]</sup>

Resident experience of phacoemulsification with topical anesthesia was reported by Unal et al. 5A BCVA of 20/40 or better was reported in 84.9% of patients in the topical group. Posterior capsular rupture with vitreous loss was seen in 6.1% of eyes. Loss of lens fragments was documented in 2.7% of eyes in the topical group. The rate of postoperative complications was 15%.

Randleman JB et al resident surgeon phacoemulsification learning curve with a BCVA of 20/40 or better in 97.8% of cases. Intraoperative complications were seen in 5% of cases with a significant reduction in vitreous loss rates after first eighty resident cases (5.1% versus 1.9%  $p=0.03$ ).

Phacoemulsification under topical anesthesia performed by resident surgeons was reported by Randleman JB et al. 86.6% cases achieved a BCVA of 20/40 or better. Postoperative complication rate was 9.9%. Vitreous loss was seen in 4.1% of cases. Tarbet KJ et al documented a 6.3% overall rate of surgical complications in phacoemulsification done by residents. 90.6% of all eyes had a BCVA of 20/40 or better.<sup>[8]</sup>

A 9.9% incidence of posterior capsular rupture was reported by Cruz OA et al. They documented a BCVA of 20/40 or better in 92.6% of eyes.<sup>[9]</sup>

Allison RJ et al reported a 14.7% incidence of vitreous loss in cases of third year residents performing phacoemulsification.<sup>[10]</sup>

A low incidence of vitreous loss of 2.8% in resident performed phacoemulsification cases was reported by Badoza et al. Mean postoperative best corrected visual acuity documented was 0.19+/-0.19.<sup>[11]</sup>

A 6.7% rate of posterior capsular disruption was reported by Bhagat N et al in resident performed phacoemulsification cases.<sup>[12]</sup>

Biomquist PH et al reported that 91% of patients had a BCVA of 20/40 or better (after excluding pre existing ocular pathology patients).<sup>[13]</sup>

Corey RP et al reported that the residents became better with subsequent cases with rate of PCR falling to nil in the later resident phacoemulsification surgeries.<sup>[14]</sup>

Quillen DA et al reported BCVA of 20/40 or better in 89% eyes and vitreous loss in 4.8% cases of resident performed phacoemulsification without prior planned ECCE experience.<sup>[15]</sup>

Rutar T et al reported that mature nuclei and zonular pathology carried increased intraoperative risk in resident performed phacoemulsification cases.<sup>[16]</sup>

Our complication rates and visual outcome are comparable to the above studies.

### **CONCLUSION**

We conclude that Phacoemulsification and MSICS can be taught to resident doctors with good visual results and a comparable rate of major surgical complications. The beginner resident surgeon graduates comfortably from MSICS to phacoemulsification with low complication rates and

good visual results. Our teaching module may be emulated by other cataract surgical training centres.

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