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Original Research Article

Learning curve of resident performed phacoemulsification versus manual small incision cataract surgery at a regional ophthalmic institute in western India

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ABSTRACT

Background: Manual small incision cataract surgery (MSICS) and phacoemulsification form part of the surgical armamentarium offered to the trainee doctors. We designed a study to document the visual outcomes and major surgical complications of manual small incision cataract surgery and phacoemulsification at our tertiary care centre.

Materials and Methods: The study was carried out at our tertiary care centre. The study design is a retrospective, institutional cohort study. Data of consecutive resident cataract surgeries done at our centre from October 2022 to April 2023 were recorded. 283 consecutive resident cataract surgical records were reviewed. MSICS was allotted to junior resident second year (JR2) and junior resident third year (JR3b) (first six months of JR3 residency) groups of residents while phacoemulsification was given to junior resident third year (JR3a) (last six months of JR3 residency) and to the senior residents (SRs). The preoperative and postoperative examination included best corrected visual acuity, intraocular pressure, thorough anterior and posterior segment examination. The surgical steps had been documented. The follow up protocol was one day, four days, fortnight, six weeks and 12 weeks. The major surgical complications were documented.

Statistical analysis was done using the student "t" test. Chi square value was calculated and a p value of less than 0.05 was taken as significant.

Results: 283 eyes of 283 patients were documented. Phacoemulsification was done in 136 cases and MSICS in 147 cases. Age, gender, grade of nucleus and the type of surgery were not significantly associated with the major surgical complication rate. The resident group was significantly associated with the major surgical complication rate (p value 0.01). The lowest complication rate was seen in JR3b operated MSICS cases (1.7%). This was closely followed by SR operated phacoemulsification cases (2.6%). 98.5% of phacoemulsification cases and 98% of MSICs cases had a best corrected visual acuity (BCVA) between 6/6 and 6/18 at 12 weeks postoperatively.

Conclusion: In conclusion both phacoemulsification and MSICS performed by resident doctors at our institute had good visual outcomes with an acceptable complication rate. As the surgical experience of the surgeon widens the surgical outcomes also improve.

1. Introduction

"The only way not to have complications is not to operate." This is true for seasoned surgeons and more so for trainee surgeons. Cataract surgery too has its

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intrinsic learning curve for the beginner surgeons. Cataract is an opacification of the crystalline lens. It is the leading cause of preventable blindness in India and worldwide.[1] Cataract surgery forms a major part of the curriculum of resident doctors pursuing a master's degree in ophthalmology in India. Manual small incision cataract surgery (MSICS) and phacoemulsification form part of the surgical armamentarium offered to the trainee doctors. A number of studies have been done to document the visual outcomes and complication rates for cataract surgeries performed by residents.[2–5] In the recent decade a subtle shift has been seen towards phacoemulsification surgeries for cataract. Beginner surgeons are now more exposed to this state of the art surgery. Studies from our institutional cohort on the resident learning curve are lacking in recent times. We designed a study to document the visual outcomes and major surgical complications of manual small incision cataract surgery and phacoemulsification at our tertiary care centre. The study findings would help in designing and upgrading resident cataract surgical training.

2. Materials and Methods

The study was carried out at our tertiary care centre. The study design is a retrospective, institutional cohort study. Data of consecutive resident cataract surgeries done at our centre from October 2022 to April 2023 were recorded. 283 consecutive resident cataract surgical records were reviewed. Informed consent had been taken from all patients. The study was approved by the institutional review board. The study adhered to the tenets of the Declaration of Helsinki. Patients had been allotted to junior residents (JR) and senior residents(SR) under the guidance of an Assistant/Associate Professor. JR3 group was subdivided into JR3a group which was in the last six months of JR3 residency. JR3b group was designated as the group in the first six months of JR3 residency. MSICS was allotted to JR2 and JR3b groups of residents while phacoemulsification was given to JR3a and to the SRs. All patients presenting with visually significant cataract to our out patient department (OPD) had been evaluated. The pre-operative workup included a visual acuity measurements, intra ocular pressure, intraocular lens powering, anterior and posterior segment examination. Routine haematology had been done including complete blood count and random blood sugar. Blood pressure had been measured. Strict control of diabetes and hypertension (if present) was mandatory before the operation. Presence of active infective focus anywhere in the body was an absolute contraindication to surgery. The exclusion criteria included high risk cases with traumatic cataracts, uniocular patients, patients younger than 35 years, zonular weakness, pseudoexfoliation syndrome, posterior polar cataracts, corneal pathology, uveitis. JR1 was allotted extracapsular cataract extraction and has been excluded from the study. The cases were done under peribulabar anesthesia. The intraoperative steps were documented. The postoperative examination included best corrected visual acuity, intraocular pressure, thorough anterior and posterior segment examination. The follow up protocol was one day, four days, fortnight, six weeks and 12 weeks. The major surgical complications were designated as posterior capsular rupture (PCR)/ zonulodialysis (ZD) with vitreous loss(VL). These cases could be with successful intraocular lens (IOL) implantation or aphakic without a successful intraocular lens implant. Nucleus drop during surgery was another main complication. IOL drop at the time of surgery or within 12 weeks postoperatively was classified as a major surgical complication. Suprachoroidal hemorrhage intraoperative and endophthalmitis, new vitreous hemorrhage, new retinal detachment within 12 weeks of surgery were also noted under major complications. Any other complication requiring re-surgery within 12 weeks of operation was also grouped as a major complication.

2.1. Statistical analysis

Statistical analysis was done using the student "t" test. Chi square value was calculated and a p value of less than 0.05 was taken as significant.

3. Results

283 eyes of 283 patients were documented. There were 137 males and 146 female cases. The male: female ratio was 0.9:1. 126 (44.5%) of the patients were </= 65 years of age while 157 (55.5%) of cases were >65 years of age. The rural : urban ratio was 1.09:1. Phacoemulsification was done in 136 cases and MSICS in 147 cases. Table 1 shows the distribution of cases amongst the various resident groups. Senior residents were allotted 77 cases of phacoemulsification and JR3a did 59 cases of phacoemulsification. 58 and 89 cases of MSICS were done by JR3b and JR2 respectively. Table 2 shows the frequency of major surgical complications in phacoemulsification versus MSICS. The rate of surgical complications in resident phacoemulsification surgeries was 6.6% while it was 8.9% in resident performed MSICS. The difference was not statistically significant at a p value of 0.48. Table 3 shows the frequency of major surgical complications as per the resident groups. The lowest complication rate was seen in JR3b operated MSICS cases (1.7%). This was closely followed by SR operated phacoemulsification cases (2.6%). The highest complication rate was seen in MSICS cases operated by JR2 (13.5%) followed by JR3a performed phacoemulsification cases (11.9%). The complication rate was significantly influenced by the residency year with the p value being 0.01. Table 4 explores the predictive factors for major surgical complications. Age, gender and grade of the nucleus were not significantly associated with the rate of

surgical complications. The resident group was significantly associated with the major surgical complication rate. The type of surgery was not significantly associated with a higher surgical complication rate. Table 5 shows the major surgical complications documented for the various surgeries. One case of phacoemulsifion had nucleus drop at the stage of hydrodissection. The case was taken up for an immediate vitrectomy with a sulcus intraocular lens implantation over the rhexis edge. In eight cases of phacoemulsification PCR with VL occurred .IOL could be successfully implanted in six cases after a thorough anterior vitrectomy. In two cases IOL implantation was done postoperatively as a sulcus fixated lens due to lack of sufficient posterior capsular support. In the MSICS cases PCR with VL was encountered in 13 cases. A successful IOL implantation after a meticulous anterior vitrectomy was possible in eleven cases. Two cases a sulcus fixated IOL was done in the immediate post operative period in the absence of a good capsular support. One case of the MSICS group with VL presented with retinal detachment 6 weeks post surgery. The RD was managed surgically. Table 6 shows the surgical step at which the complications were encountered. Three cases of phacoemulsification PCR occurred while emulsifying the last nucleus piece. In five cases PCR with VL was encountered during the irrigation-aspiration (I/A) step. In the MSICS group in five cases PCR with VL was encounterd during nucleus prolapse and /or extraction stage. The rest eight cases had a PCR with VL during the I/A of the cortical matter. Table 7 shows the visual outcome of resident performed phacoemulsification and MSICS. 98.5% of phacoemulsification cases and 98% of MSICS cases had a best corrected visual acuity (BCVA) between 6/6 and 6/18 at 12 weeks postoperatively. Two cases in the phacoemulsification group and three cases in the MSICS group achieved a BCVA of <6/18 to 6/60. This could be attributed to dry age related macular degeneration in four cases. One case of retinal detachment had high myopia with maculopathy accounting for the vision.

Table 1: Case distribution among the resident groups

Resident	Number of cases(%)
SR	77(27.3%)
JR3a	59(20.8%)
JR3b	58(20.5%)
JR2	89(31.4%)
Total	283(100%)

4. Discussion

Cataract surgery forms the basic armamentarium of the residency teaching program. Phacoemulsification and MSICS form the cornerstones of the cataract surgical training. There are few articles comparing phacoemulsification and MSICS in trainee surgeons.[2,3] There are a plethora of research articles on the outcomes of phacoemulsification in trainee surgeons.[4–16] At our centre phacoemulsification and MSICS were performed by resident surgeons with good visual outcomes and a comparable rate of surgical complications. The rate of surgical complication was significantly affected by the surgeon group. The senior surgeon in each group performing better than the less experienced junior counterpart. Thus, a learning curve was evident foe each surgical group. PCR with VL was the most common complication. I/A was the most common step at which complication was encountered in both surgeries followed by the step of nucleus management.

A study from South India reported a complication rate of 1.11% for phacoemulsification, 1.01% for MSICS and 2.6% for extracapsular cataract extraction (ECCE). Their study group included faculty, fellows, resident doctors and visiting trainees.[2] In a study comparing the complication rate of ECCE versus phacoemulsification for resident surgeons, a 2.5% complication rate was reported for phacoemulsification and a 4.1% complication rate for ECCE.[3] In another study on phacoemulsification done by resident doctors there was a 10% rate of VL .94.8% of cases had a BCVA of >/= 6/12.[4] Phacoemulsification done under topical anaesthesia by resident doctors had a 6.1% rate of PCR with VL in a study by Unal et al.[5] Nucleus drop was documented in 2.7% of cases. An average 15% rate of postoperative complications was reported for the beginner phacoemulsification surgeries.[5] Randleman JB et al compared the complication rate in first eighty resident cases of phacoemulsification versus the complication rate in subsequent cases. They found that the frequency of VL reduced from 5.1% to 1.9% in the two groups.The p value was significant at 0.03. An overall BCVA of 20/40 or more was aceived in 97.8% of cases.[6] In our study also the rate of complications significantly (p value=0.01) reduced from 11.9%(JR3a) to 2.6% (SR) as the experience of phacoemulsification increased. In another study of phacoemulsification done under topical anaesthesia by resident doctors VL was documented in 4.1% of cases. 9.9% was the overall postoperative complication rate. A BCVA of 20/40 or more was achieved in 86.6% of cases.[7] In independent studies Tarbet KJ et al and Cruz OA et al reported a 6.3% and 9.9% rate of complications in phacoemulsification surgeries performed by residents. A BCVA of 20/40 or better was achieved in 90.6% and 92.6% of cases respectively.[8,9] A rate of VL of 14.7% was reported by Allison RJ in cases of JR3 performed phacoemulsification surgeries.[10] In independent studies of Badoza et al and Bhagat et al the major surgical complication rate was 2.8% and 6.7% respectively. The visual outcomes were good.[11,12] Biomquist et al. reported good visual outcomes even after VL in resident performed cataract surgeries.[13]

Table 2: Frequency of major surgical complications in MSICS versus phacoemulsification

Surgical Technique	Cases without major surgical complications n(%)	Cases with major surgical complications n (%)	Total n (%)
Phacoemulsification	127(93.4%)	9(6.6%)	136(100%)
MSICS	134(91.1%)	13(8.9%)	147(100%)
Total	261(92.2%)	22(7.8%)	283(100%)

P value of 0.48737 for complication rate in phacoemulsification versus MSICS is not significant at p < 0,05.

Table 3: Frequency of major surgical complications as per year of residency

Surgeon	Cases without major surgical complications n(%)	Cases with major surgical complications n (%)	Total n (%)
SR	75(97.4%)	2(2.6%)	77(100%)
JR3a	52(88.1%)	7(11.9%)	59(100%)
JR3b	57(98.3%)	1(1.7%)	58(100%)
JR2	77(86.5%)	12(13.5%)	89(100%)
Total	261(92.2)	22(7.8%)	283(100%)

p value of 0.03 for complication rate of SR versus JR3a is significant at p <0.05. p value. P value of 0.01 for complication rate of JR3 versus JR2 is significant at p <0.05

Table 4: Predictive factors for major surgical complications

Factor	Surgeries without complications	Surgeries with complications	Total	p value
Age (years)				
</=65	119	7	126	0.21
>65	142	15	157	
Gender				
Male	128	9	137	0.47
Female	133	13	146	
Nuclear grade				
NS1+/NS2+	43	2	45	0.26
NS3+	131	9	140	
NS4+	87	11	98	
Resident				
SR	75	2	77	
JR3a	52	7	59	0.01
JR3b	57	1	58	
JR2	77	12	89	
Surgery				
Phacoemulsification	127	9	136	0.48
MSICS	134	13	147	

Table 5: Major surgical complications documented

Complication	Phacoemulsification	MSICS	Total
PCR/ZD &VL with IOL	6	11	17
PCR/ZD &VL without IOL	2	2	4
Nucleus drop	1	-	1
IOL drop	-	-	-
Suprachoroidal hemorrhage	-	-	-
Endophthalmitis	-	-	-
VH/RD within 12 weeks of surgery	-	1	1

Table 6: Step ofsurgery at which complication occurred

Step of surgery	Phacoemulsification	MSICS	Total
Capsulorrhexis	-	-	-
Hydroprocedures	1	-	1
Nucleus management	3	5	8
Irrigation/Aspiration	5	8	13
IOL Implantation	-	-	-
Others	-	-	-

Table 7: Visual outcome of resident surgeries

BCVA	Phacoemulsification	MSICS	Total
6/6 – 6/18	134(98.5%)	144 (98.0%)	278 (98.2%)
<6/18 – 6/60	2(1.5%)	3(2.0%)	5(1.8%)
<6/60	-	-	-
Total	136(100%)	147 (100%)	283(100%)

In our study also even after VL the visual outcomes were good in resident surgeries. Corey et al reported on the learning curve of resident phacoemulsification cases. The rate of complications as PCR with VL reduced significantly comparing early versus late resident performed phacoemulsification cases.[14] In a study of phacoemulsification surgeries done by beginner resident surgeons without previous ECCE experience the rate of VL was 4.8% with good visual outcomes.[15] In a study exploring the risk factors for resident operated phacoemulsification cases, mature cataract and zonular weakness were identified as risk factors for complicationa.[16]

5. Conclusion

In conclusion both phacoemulsification and MSICS performed by resident doctors at our institute had good visual outcomes with an acceptable complication rate. There was no statistically significant difference in the visual outcome and complication rates of the two surgeries. The complication rates for phacoemulsification were higher at JR3a level vis-à-vis SR. Similarly, the complication rate of MSICS was higher at JR2 group versus the JR3b group. Thus, junior surgeons need greater supervision especially during nucleus management and I/A steps. As the surgical experience of the surgeon widens the surgical outcomes also improve.

6. Source of Funding

None.

7. Conflict of Interest

None.

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