Original Article

Effect of wet-laboratory training on resident performed manual small-incision cataract surgery

Soumya Ramani, Thanuja Gopal Pradeep, Divya D Sundaresh

Purpose: The aim of this study was to study the effect of wet-laboratory training on the surgical outcome of resident performed manual small-incision cataract surgery (MSICS). **Methods:** We conducted a retrospective, comparative observational study on resident performed MSICS in our institute. We collected data of 464 patients of which Group A had 232 cases performed by residents without prior wet-laboratory training and Group B had 232 resident performed cases after adequate skill training in the wet laboratory. The demographics, type of cataract, intraoperative, postoperative complications, and immediate visual outcome were compared between the two groups. **Results:** The age, sex, and type of cataract were similar in both groups of residents. The frequency of intraoperative complications was higher in Group A (23.7%) than in Group B (15.08%) (P = 0.019). The occurrence of posterior capsule (PC) rupture and vitreous loss showed a statistically significant difference, with Group A showing a high rate of 14.3% PC rent and vitreous loss while only 6.9% (P = 0.01) had this complication in Group B. The postoperative visual outcome also was better in Group B than in Group A, with 62.06% of patients in Group B, having a postoperative day 1 vision of better than 6/18 as compared to only 38.36% in Group A. **Conclusion:** The wet-laboratory training is an effective method of improving the skills of the ophthalmology residents in MSICS. The reduction of complications will improve the quality of surgery and improve the postoperative visual outcome.

Key words: Complications, manual small-incision cataract surgery, resident performed surgery, visual outcome, wet-laboratory training

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Cataract surgery is the most commonly performed surgery worldwide. India, as a signatory to Vision 2020 has committed to eliminate avoidable blindness by 2020. The quantum of cataract surgery is expected to double from 3.38 million in 2001 to 7.63 million in 2020. This lays the burden on the effective training of cataract surgeons.[1]

In developing countries, such as India where resources for health-care services are limited, training of residents in a cost-effective procedure such as manual small-incision cataract surgery (MSICS) becomes imperative. It has also been shown that resident performed MSICS has a low rate of complications when compared to resident performed phacoemulsification.[2] A meta-analysis done by Gogate *et al*. also shows that there are no significant differences between phacoemulsification and MSICS regarding complications and visual outcome and hence training of residents in this cost-effective procedure has an added advantage in our country.[3]

Wet-laboratory training helps the residents to master the initial steps of stereoscopic vision, hand–eye coordination and microsurgical skills in a nonstressful laboratory setting. This exposure not only increases the individual resident's technical proficiency but also enhances their confidence and all the while increasing the patient safety. The importance of wet-laboratory training in ophthalmic residency has been recognized and mandated by the Accreditation Council of Graduate Medical Education (ACGME) in 2005 and these facilities are available across the USA to all the ophthalmology trainees.[4]

In India, too there is a need for adequate training of the ophthalmology residents before they are allowed to operate on the patients. There are various studies reporting the inconsistencies in the training across institutes in India and the lack of wet-laboratory training in Indian institutes.[5-7] Keeping in line with this, we introduced wet-laboratory training for residents in March 2013 where students had a structured curriculum for wet laboratory, which they had to complete before they were allowed into the operating theater where they were again trained under the supervision. We have studied the resident-performed cases before and after the introduction of wet-laboratory training and its influence on the outcome of surgeries.

Methods

This study was conducted after approval from the Institutional Review Board of our institute.

Wet-laboratory training was introduced in our institute in March 2013 wherein the residents are trained in a stepwise manner in hand–eye coordination and the steps of cataract

Department of Ophthalmology, Ramaiah Medical College, Bengaluru, Karnataka, India

Correspondence to: Dr. Thanuja Gopal Pradeep, 705, Renaissance Park 2, Subramanyanagar, Malleswaram West, Bengaluru - 560 055, Karnataka, India. E-mail: thanugopal@yahoo.co.in

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surgery. The residents were initially trained in hand–eye coordination that included suturing on foam under microscope (3-step, Leica microscope) for two classes. They were then trained with goat's eye for the scleral tunnel, entry into anterior chamber and capsulotomy for 6 weeks (12 Goat's eye each). After 2 months of wet-laboratory training, they were allowed to perform cataract surgeries under supervision in the operating theater followed by regular monthly training of 6 h/month during their first 2 years of residency.

We conducted a cross-sectional comparative study, wherein records of 464 patients were reviewed. The information was abstracted from the surgical records in the Department of Ophthalmology of our institute and all the resident-performed surgeries were identified. Of these, those performed before wet-laboratory training was introduced in our institute, i.e., March 2013 and those after, were classified into Groups A and B, respectively (Time period - January 2012–July 2014). Both groups included 232 patients each.

The demographic data, diagnosis, type of surgery performed, postoperative vision, and intraoperative and postoperative complications for the surgeries performed by both groups were recorded and compared.

The Statistical Package for the Social Sciences software version 18.0 (SPSS Inc., Chicago, IL, USA) was used for data analysis. The Chi-squared test was used and a value of $P < 0.05$ was considered as statistically significant.

Results

The age, sex, and type of cataract-when compared between the two groups were similar with no statistically significant difference between the two groups. It is shown in Table 1.

When we compared the combined intraoperative complications between the two groups, it was seen that the Group A had a higher rate of complications with 23.7% of cases having complications as opposed to only 15.08% in Group B. When each individual complication was analyzed, peripheral iridectomy was done more frequently in Group A as compared to Group B. There was no difference between the two groups in proportion of tunnel complications, descemet's membrane detachment, and zonular dehiscence.

The occurrence of posterior capsule (PC) rupture and vitreous loss showed a statistically significant difference, with Group A showing a high rate of PC rent and vitreous loss (14.3%) while only 6.9% had this complication in Group B.

Nucleus drop was also seen in two cases of Group A whereas none in Group B had this complication. The comparison of intraoperative complications between the two groups is shown in Table 2.

The rate of intraocular lens implantation and the type of lens implanted is shown in Table 3. The frequency of posterior chamber intraocular lens (PCIOL) was higher in the Group B. Iris claw lens were not used before 2013 in our institute, which is reflected in the higher proportion of implantation among Group B patients.

The postoperative day 1 vision was compared between the two groups and is represented in Table 4. As shown in the table, Group B patients had a better vision on the postoperative day 1. The postoperative vision mirrored the higher occurrence of intraoperative and postoperative complications in Group A with 13.36% of patients in Group A having vision of less than counting fingers at 3 m as compared to Group B ($P = 0.00$).

When postoperative complications were compared between the two groups, it was shown that the Group B had a statistically significant lower frequency of complications. The occurrence of complications is shown in Table 5.

Table 1: Comparison of demographics between Group A and B

	Group A (%)	Group B (%)
Age (years)		
40-60	107 (46.2)	97 (41.8)
Above 60	122 (52.62)	135 (58.2)
Sex		
Male	101 (43.4)	96 (41.4)
Female	131 (56.46)	136 (58.6)
Type of cataract		
Immature cataract	124 (53.4)	144 (62)
Mature cataract	52 (22.4)	39 (16.8)
Hypermature cataract	7 (3)	10 (4.3)

Table 2: Comparison of intraocular complications between the two groups

	Group A (%)	Group B (%)
Total intraoperative complications	55 (23.7)	35 (15.08) (P=0.019)
Tunnel complications		
Button holing	2 (0.86)	5 (2.15)
Premature entry	4 (1.72)	3 (1.29)
Iris complications		
Iris prolapse	6 (2.5)	6 (2.5)
Sphincterotomy	2 (0.8)	0
Iris tear	1 (0.4)	0
Peripheral iridectomy	18 (7.7)	3 (1.3)
Iridodialysis	13 (5.6)	1 (0.4)
Descemet's detachment	3 (1.3)	4 (1.7)
Zonular dehisence		
Dehisence <3 clock hours	1 (0.4)	5 (2.15)
Dehisence >3 clock hours	1 (0.4)	1 (0.4)
PC rent/vitreous loss	33 (14.3)	16 (6.9) (P=0.01)
Nucleus drop	2 (0.86)	0

PC: Posterior capsule

Table 3: Comparison of the rate of intraocular lens implantation between the two groups

Group	PCIOL (%)	ACIOL (%)	Iris claw (%)	Aphakia (%)
Group A	205 (88.6)	18 (7.7)	0	9 (3)
Group B	221 (95.2)	0	7 (3) (P=0.00)	4 (1.7)

PCIOL: Posterior chamber intraocular lens, ACIOL: Anterior chamber intraocular lens

Table 4: Postoperative vision on day 1

Group	6/18 or better (%)	6/60 to 6/18 (%)	6/60 to CF 3 m (%)	Less than CF 3 m (%)
Group A	89 (38.36)	90 (38.79)	22 (9.4)	31 (13.4)
Group B	144 (62.06)	51 (21.98)	18 (7.7)	19 (8.2)

CF3m = counting fingers at 3 m

Table 5: Comparison of postoperative complications between the two groups

	Group A (%)	Group B (%)
Postoperative complications	156 (67.24)	126 (54.3) (*P*=0.0005)
Microcystic edema	23	37 (*P*=0.053)
Irregular pupil	46	12 (*P*=0.000)
AC complications*	28 (12.06)	13 (5.6)

*AC complications included-fibrinous exudate, shallow AC, hyphema, cortical matter and vitreous in anterior chamber. AC: Anterior chamber

Further we analyzed, the intraoperative and postoperative outcome based on the resident training level. The intraoperative complications according to the residency level are shown in Table 6. The table shows that the maximum difference between the two groups was seen in the 2nd-year residents (JR2) who had a statistically significant lower incidence of complications, especially PC rupture and vitreous loss. This may be because the supervising expert more closely supervises the 1st-year residents with higher takeover of the case.

When the intraocular lens placed in each group according to the residency level was analyzed, a statistically significant difference was seen in the 2nd-year residents, with a higher number in the Group B, Having placed a PCIOL [Table 7].

Discussion

There are various studies, which have compared cataract surgeries performed by residents with those done by experienced surgeons, and have shown that with experience the visual outcome becomes better and the complications reduce. Haripriya *et al*.[2] revealed in a study, on a large population done in South India, that the cataract surgery outcome was significantly better when performed by the staff surgeons (0.76%), as compared to residents (2.06%), and trainees (5%).[2] The combined complication rate for trainees in phacoemulsification was 4.8% as compared to 1.46% in MSICS. In this study, too we saw that 3rd-year residents were performing better than the 1st-year residents in both groups. With experience, the visual outcome of cataract surgery becomes better, but our aim should be to provide an effective stress-free training to the residents during their residency to reduce complications.

Ophthalmic surgery is different from other surgical fields, as it requires additional skills of hand–eye coordination. Microsurgery allows only one person to operate at a time; hence, does not give ample time for the supervisor to intervene before a complication occurs. The residents operate under a highly demanding and stressful environment that may hamper their development as good surgeons. There are various studies published which aim at improving the training and surgical outcome of trainee operated cases. Rogers *et al*. showed that the implementation of a structured curriculum for the ophthalmic residents significantly reduced the rate of complications, especially PC rupture and vitreous loss.[8] In their study, the 1st- and 2nd-year residents went through intensive wet-laboratory training and supervised surgical training, thus emphasizing the need for training of microskills at a skills laboratory before residents are allowed to operate on patients. Khanna *et al*. also concluded in their study, that having a uniform standard of training can result in improvement of outcomes irrespective of the surgery performed.[9] In this study, too we found that a statistically significant difference was seen among the 2nd-year residents who showed a remarkable improvement regarding reduced intraoperative complications (posterior capsular rupture [PCR] $P = 0.002$) and better postoperative visual outcome after wet-laboratory training.

There are various studies reporting the effectiveness of simulator training for phacoemulsification. The occurrence of intraoperative complications was significantly reduced in residents trained on the simulator.[10-12]

Suryawanshi *et al*. have tried a reverse method of training residents in cataract surgery and shown there is no difference in the conventional versus the reverse method of training. These studies only emphasize that various modalities have been tried to improve the resident surgical outcomes.[13]

The ACGME has recognized the importance of wet-laboratory and simulator training in ophthalmology residency and mandated the wet-laboratory or simulation training in the USA for ophthalmology training.[2] The pitfall of this is the cost involved in setting up and maintaining the wet laboratory. However, in the long run, it definitely has the benefit of improving trainee confidence and the quality of surgeries.

In the Indian scenario, cost of phacoemulsification may be a hindrance in providing it to the general population; hence, training in MSICS becomes imperative. Small-incision cataract surgery also requires microsurgical skill training and the residents would benefit by wet laboratory exposure. This is shown in our study, where the frequency of intraoperative complications significantly fell after the introduction of wet-laboratory training in our institute. Furthermore, postoperative visual outcome of resident performed surgery remarkably improved. This difference was seen in the 2nd-year residents who revealed a statistically significant difference in both the rate of intraoperative complications (PCR; $P = 0.002$) and visual outcome.

The rate of PC rent and vitreous loss in resident performed surgeries varies in different studies ranging from 4.9% to 10%.[14-18] In this study, we have included all the levels of trainees - 1st (JR1), 2nd (JR2), and 3rd-year residents (JR3) whereas most of the studies include only 2nd and 3rd-year residents. The rate of vitreous loss in the study, in Group A without prior access to wet-laboratory training is high - 14.3% whereas after

Table 6: Comparison of intraoperative complications in different resident level

	Group A (%)	Group B (%)
1st year (JR1)		
Intraoperative complications	13 (14.4)	10 (13.5) (*P*=0.864)
Tunnel complications	1 (1.11)	1 (1.36)
PC rupture	8 (8.9)	5 (6.8) (*P*=0.615)
2nd year (JR2)		
Intraoperative complications	31 (30.4)	20 (16)
Tunnel complications	4 (3.9)	6 (4.8)
PC rupture	19 (18.6)	7 (5.6) (*P*=0.002)
3rd year (JR3)		
Intraoperative complications	11 (27.5)	5 (15.2)
Tunnel complications	1 (0.4)	1 (0.4)
PC rupture	7 (17.5)	2 (6.1) (*P*=0.139)

PC: Posterior capsule

Table 7: Comparison of Intraocular placement between the two groups

Group	PCIOL (%)	ACIOL (%)	Iris claw (%)	Aphakia (%)
Group A	205 (88.6)	18 (7.7)	0	9 (3)
1st year	84 (93.3)	4 (4.4)		2 (1.2)
2nd year	86 (84.3)	11 (4.8)		5 (4.9)
3rd year	35 (87.5)	2 (5)		3 (7.5)
Group B	221 (95.2)	0	7 (3) (*P*=0.00)	4 (1.7)
1st year	70 (94)		2 (2)	2 (1.2)
2nd year	120 (96)		3 (2.4)	2 (1.6)
3rd year	31 (93.9)		2 (6.1)	0

PCIOL: Posterior chamber intraocular lens, ACIOL: Anterior chamber intraocular lens

wet-laboratory training, the rate of PCR and vitreous loss is 6.9% which is comparable with other studies.[9] Carricondo *et al*. in their study of the 3rd-year residents showed an 11.54% of intraoperative complications.[19] In this study, they showed that the rate of intraoperative complications, which was as high as 14% in the first 40 cases, dropped to 7% after 80 cases. The results are comparable with this study with a remarkable improvement in the 2nd-year residents revealing a rate of PCR of 5.6%, which was achieved between 40 and 80 cases. The studies that are published are for phacoemulisification training, and to the best of our knowledge, there is no publication on the effect of wet-laboratory training on small-incision cataract. Ours is the first publication addressing this issue.

One of the limitations of this study is that it is a retrospective study. However, once the wet laboratory curriculum was instituted in our center, it was considered discriminatory to conduct a randomized trial where the advantage of wet laboratory curriculum would be provided to some students and the rest would be deprived of the same. Another limitation was that the innate skill levels of each resident might vary.

Conclusion

A wet-laboratory training facility plays a major role in enhancing the confidence and surgical skills in the resident which is ultimately manifested in the reduced rate of complications and a better visual outcome in resident-performed cataract surgery. The need to mandate the wet laboratory or simulation facility in ophthalmology training as a part of the curriculum in postgraduate training in India requires serious consideration to improve the cataract surgical outcomes.

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Conflicts of interest

There are no conflicts of interest.

References

1. Murthy G, Gupta SK, John N, Vashist P. Current status of cataract blindness and vision 2020: The right to sight initiative in India. Indian J Ophthalmol 2008;56:489-94.
2. Haripriya A, Chang DF, Reena M, Shekhar M. Complication rates of phacoemulsification and manual small-incision cataract surgery at Aravind Eye Hospital. J Cataract Refract Surg 2012;38:1360-9.
3. Gogate P, Optom JJ, Deshpande S, Naidoo K. Meta-analysis to compare the safety and efficacy of manual small incision cataract surgery and phacoemulsification. Middle East Afr J Ophthalmol 2015;22:362-9.
4. Accreditation Council for Graduate Medical Education. ACGME Program Requirements for Graduate Medical Education in Ophthalmology; 2007.
5. Gogate P, Deshpande M, Dharmadhikari S. Which is the best method to learn ophthalmology? Resident doctors' perspective of ophthalmology training. Indian J Ophthalmol 2008;56:409-12.
6. Gogate P, Biswas P, Natarajan S, Ramamurthy D, Bhattacharya D, Golnik K, *et al*. Residency evaluation and adherence design study: Young ophthalmologists' perception of their residency programs – Clinical and surgical skills. Indian J Ophthalmol 2017;65:452-60.
7. Ajay K, Krishnaprasad R, Divya DS. Ophthalmic surgical training in Karnataka and southern India: Present status and future interests from a survey of final-year residents. Indian J Ophthalmol 2015;63:306-11.
8. Rogers GM, Oetting TA, Lee AG, Grignon C, Greenlee E, Johnson AT, *et al*. Impact of a structured surgical curriculum on ophthalmic resident cataract surgery complication rates. J Cataract Refract Surg 2009;35:1956-60.
9. Khanna RC, Kaza S, Palamaner Subash Shantha G, Sangwan VS. Comparative outcomes of manual small incision cataract surgery and phacoemulsification performed by ophthalmology trainees in a tertiary eye care hospital in India: A retrospective cohort design. BMJ Open 2012;2. pii: e001035.
10. Solverson DJ, Mazzoli RA, Raymond WR, Nelson ML, Hansen EA, Torres MF, *et al*. Virtual reality simulation in acquiring and differentiating basic ophthalmic microsurgical skills. Simul Healthc 2009;4:98-103.
11. Belyea DA, Brown SE, Rajjoub LZ. Influence of surgery simulator training on ophthalmology resident phacoemulsification performance. J Cataract Refract Surg 2011;37:1756-61.
12. Feudner EM, Engel C, Neuhann IM, Petermeier K, Bartz-Schmidt KU, Szurman P, *et al*. Virtual reality training improves wet-lab performance of capsulorhexis: Results of a randomized, controlled study. Graefes Arch Clin Exp Ophthalmol 2009;247:955-63.
13. Suryawanshi M, Gogate P, Kulkarni AN, Biradar A, Bhomaj P.

Comparison of the posterior capsule rupture rates associated with conventional (Start to finish) versus reverse methods of teaching phacoemulsification. Middle East Afr J Ophthalmol 2016;23:163-7.

14. Bhagat N, Nissirios N, Potdevin L, Chung J, Lama P, Zarbin MA, *et al.* Complications in resident-performed phacoemulsification cataract surgery at new jersey medical school. Br J Ophthalmol 2007;91:1315-7.
15. Prasad S. Phacoemulsification learning curve: Experience of two junior trainee ophthalmologists. J Cataract Refract Surg 1998;24:73-7.
16. Randleman JB, Wolfe JD, Woodward M, Lynn MJ, Cherwek DH, Srivastava SK, *et al.* The resident surgeon phacoemulsification learning curve. Arch Ophthalmol 2007;125:1215-9.
17. Albanis CV, Dwyer MA, Ernest JT. Outcomes of extracapsular cataract extraction and phacoemulsification performed in a university training program. Ophthalmic Surg Lasers 1998;29:643-8.
18. Dooley IJ, O'Brien PD. Subjective difficulty of each stage of phacoemulsification cataract surgery performed by basic surgical trainees. J Cataract Refract Surg 2006;32:604-8.
19. Carricondo PC, Fortes AC, Mourão Pde C, Hajnal M, Jose NK. Senior resident phacoemulsification learning curve (corrected from cure). Arq Bras Oftalmol 2010;73:66-9.