Original Article

Residency Evaluation and Adherence Design Study III: Ophthalmology residency training in India: Then and now–Improving with time?

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Purpose: To gauge the differences in ophthalmology residency training, academic, clinical and surgical, in the last three decades of the 20th century and the first decade of the 21st century. **Methods:** A survey was conducted by the Academic and Research Committee of the All India Ophthalmological Society, in 2014–2016, using a prevalidated questionnaire, which was circulated to ophthalmologists to gauge the practicality of the teaching protocols of clinical and surgical skills during postgraduate residency program. **Results:** Of the 1005 respondents, 320 ophthalmologists who completed residency between 1967 and 2002 (20th century trained) and 531 who completed a residency in 2003–2012 (21st century trained) fulfilled the inclusion criteria. The average age was 49.2 years (standard deviation [SD] 4) and 32.6 years (SD 4), respectively. Twenty-first century trained ophthalmologists rated their training significantly better than the 20th century trained ophthalmologists for slit lamp examination ($P = 0.001$), indirect ophthalmoscopy, gonioscopy, automated perimetry, optical coherence tomography, and fundus photography (all having $P < 0.001$), while the 20th century trained rated their teaching of refraction, synoptophore, diplopia charting better (all $P < 0.001$). The range of grading was 0–10 in all categories. The median number of surgeries performed independently by 20th century and 21st century trained (during their training period) were: intracapsular cataract extraction (ICCE) 10, 0; extracapsular cataract extraction (ECCE) 43, 18; small incision cataract surgery (SICS) 5, 55; phacoemulsification (Phaco) 0, 1; pterygium excision 20, 15; dacryocystectomy 11, 4; dacryocystorhinostomy 11, 2; chalazion 35, 30; trabeculectomies 5, 0; strabismus correction 0, 0; vitrectomy 0, 0; keratoplasty 0, 0; eyelid surgery 6, 2; and ocular emergencies 18, 20. **Conclusion:** Teaching of many clinical skills had improved over decades. Cataract surgery training has shifted from ICCE and ECCE to SICS and Phaco, but other surgeries were still taught sparingly. There was an enormous variation across the country in residency training which needs immediate attention.

Access this article online

Website: www.ijo.in

DOI: 10.4103/ijo.IJO_108_17

Quick Response Code:

Key words: India, ophthalmology residency, postgraduate medical education, residency training

Residency training of postgraduate medical students is the base for all medical specialty training. Ophthalmology, a surgical specialty, is no exception to this. The goal of a postgraduate educational program in ophthalmology is training for practice. The practice involves being competent to diagnose, treat, and manage the most common conditions encountered in clinical practice effectively and with minimal error.

Conventionally, this has meant acquisition of knowledge and skills for decision-making and operative skills. In addition, the dissertation has been a part of the postgraduate courses to develop the residents' research skills. Other competencies identified more recently as being an important part of the postgraduate curriculum includes professionalism and ethics, communication, leadership, social accountability, and an understanding of systems-based practice.

Curriculum is dynamic and is expected to change in keeping with the scientific advancements of the particular specialty. While regulatory bodies and universities continue to update their curricula regularly (the "declared curriculum"),[1,2] the "taught curriculum" predominates in the residency program. Although congruence between declared and taught is the ideal, there is a variance in adherence.

In the past decades, ophthalmology practice has changed tremendously. Intracapsular cataract extraction (ICCE) surgery, the surgery of choice for cataract extraction till the 1970s has given way to phacoemulsification (Phaco) and small incision cataract surgery (SICS). Glaucoma

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Manuscript received: 08.02.17; Revision accepted: 18.06.17

Cite this article as: Biswas P, Gogate PM, Maskati QB, Natarajan S, Verma L, Bansal PK. Residency Evaluation and Adherence Design Study III: Ophthalmology residency training in India: Then and now–Improving with time?. Indian J Ophthalmol 2018;66:785-92.

management and treatment of retinal disorders have undergone a sea change.

However, there are few studies documenting if and how the residency training has changed or progressed with time. The Academic and Research Committee of the All India Ophthalmological Society had commissioned a survey to understand the functionality of ophthalmological residency training. There have been numerous studies from India, China, Canada, and Unites States of America regarding the efficacy of residency training, but none comparing it across time.[3-13] This manuscript presents the feedback of residency training of those who were trained in the last decades of the 20th century and compares it with the feedback on training imparted in the first decade of the 21st century. Clinical skills learnt, surgical training and demographic factors were compared between both the groups.

This study endeavors to capture the change over time in the trend related to the choice of ophthalmology as a specialty, the nature of educational experience during the residency and ways in which the graduates advance their careers and continue to develop professional skills. The research question that the study seeks to answer is: What is the changing trend of ophthalmology residency programs from the last decades of the 20th century to the first decade of the 21st century.

Methods

This was a cross-sectional study to explore the changes in teaching practice in ophthalmology residency programs in India, using a prevalidated questionnaire. The survey was prevalidated by having it vetted by six researchers and educationists and then doing a pilot study on a sample of 15 ophthalmologists. The All India Ophthalmological Society (AIOS) through its Academic and Research Committee commissioned a survey of residency training. The study population was ophthalmologists who were trained in India.

The "change" was studied between two cohorts that graduated at different points in time: Group A (20th century trained) who started training between 1967 and 2001 and graduated before 2002 and Group B (21st century trained) that enrolled between 2003 and 2012 and graduated before 2014. The respondents were asked to grade clinical skills and surgeries learnt and performed during their residency. They had the choice of anonymity but were also asked certain demographic information and details of their academic program and research project during residency training. The details are in Appendix 1.

Although the survey aimed at getting feedback from 21st century trained ophthalmologists, it was kept open for all ophthalmologists. The survey was circulated among all members of the AIOS, irrespective of their seniority and was open to all ophthalmologists (both members and nonmembers). There were repeated reminders through E-mails, text messages, and later phone calls to participate in the study. Heads of institutions of excellence retired, and serving Professors were requested to send the survey link to their past students. Telephone, E-mail, and text message reminders were sent to potential respondents on 11 occasions between October 2014 and February 2016. Incomplete responses were not considered.

The collected data were organized into four categories – (1) demographic data, (2) training place characteristics, (3) curricular aspects, and (4) career advancement following the training.

The aim was to understand the differences in the training methods and outputs over the past decades. Respondents had to fill their demographic details, the institution where their residency was completed, clinical examination skills learnt and surgeries observed, assisted, operated under supervision and independently during the residency training. A section dealt with the dissertation done by the residents and whether it was presented and/or published. The immediate future plans and need for further training by the respondents was a part of the questionnaire.

The data were entered into Excel Worksheets and Statistical Package for Social Sciences (SSPS version 16), IBM Corporation, Armonk, New York, USA was used for data analysis. Mean, standard deviation (SD), and median of the responses was considered.

Results

A total of 320 ophthalmologists who did their residency in the last decades of the 20th century completed the questionnaire, 75 (23.4%) were females. Their average age was 49.2 years (SD 8.7, range 37–84), median 47 years. They had completed their residency between 1967 and 2002. One hundred and twenty-eight (39.9%) were from metro cities, 93 (29%) from large towns, 70 (21.8%) from district headquarters while 18 (56%) from smaller towns or villages. Twenty-three (7.2%) were MD, 107 (33.3%) were master of surgery in ophthalmology, 58 (18.1%) were diplomate of the national board in ophthalmology while 81 (25.2%) were diploma in ophthalmology. Only 15 (4.7%) came from a family of ophthalmologists. Ninety-eight (30.5%) chose ophthalmology as they believed it had good career prospects. Twenty-one (6.5%) chose ophthalmology for financial gains and 67 (20.9%) chose ophthalmology for improvement of knowledge. Eighteen (5.6%) worked in a government hospital, 28 (8.7%) in a nongovernment organization hospital, 49 (15.3%) in a teaching institution, 66 (20.6%) in private practice, and 15 (4.7%) in group practice. The rest did not give details about the type or nature of their practice. The data of 21st century trained ophthalmologists have been published in this journal earlier.[14,15]

Table 1 shows how the 20th century trained ophthalmologists rated their clinical skills and education while undergoing residency training. Refraction, slit lamp examination, and direct ophthalmoscopy were taught well. However, exposure to equipment oriented skills such as perimetry, fundus photography, fluorescein angiography, optical coherence tomography (OCT), and B-scan and A-scan ultrasonography was not taught to their satisfaction. Contact lens evaluation was taught to 109 (52.6%) of the survey respondents.

Table 2 demonstrates the surgical experience gained by the 20th century trained during their residency training. ICCE surgery was second to conventional extracapsular cataract extraction (ECCE) surgery as the most common surgery performed in the residency. Except for ECCE, there was a large difference in the mean and median for ICCE, SICS, and

Phaco. There was a substantial variation across residency training programs for surgeries observed, assisted, performed under supervision, and surgeries performed independently. The standard deviation was more, as some programs gave insufficient surgical exposure to residents. Pterygium excision, sac surgeries, and ocular emergencies were more regularly a part of programs.

Table 1: Teaching of clinical skills as rated by 20th century trained ophthalmologists

	Range	Average (SD)	Median
Refraction	0-10	6.5 (2.9)	7
Slit lamp examination	0-10	6.4 (3.3)	7
Automated perimetry	0-10	3.8 (3.8)	3
Fundus Photography	0-10	3.7 (3.7)	2
Direct ophthalmoscopy	0-10	7.5 (2.7)	8
Pachymetry	0-10	2.5 (3.5)	0
OrthopticEvaluation	0-10	4.7 (3.1)	5
Fluorescein angiography	0-10	3.7 (3.6)	3
Applanation tonometry	0-10	4.2 (3.8)	4
Optical coherence tomography	0-10	1.7 (3.1)	0
Gonioscopy	0-10	4.4 (3.7)	4
A-scan biometry	0-10	4.9 (3.7)	5
+78/+90D	0-10	3.8 (3.8)	3
B-scan ultra-sonography	0-10	3.9 (3.7)	3
Indirect ophthalmoscopy	0-10	4.6 (3.4)	4
Synoptophore	0-10	4.0 (3.2)	4
Keratometry	0-10	5.6 (3.4)	6
Hess charting	0-10	4.2 (3.3)	4
Paediatric visual acuity testing	0-10	3.0 (3.0)	2
YAG LASER capsulotomy	0-10	4.1 (3.9)	3
Retinal LASERs	0-10	2.3 (3.3)	0
YAG iridotomy	0-10	3.6 (3.7)	2

Table 3 compares the demographics between 20th century trained and 21st century trained ophthalmologists in this study. Table 4 compares the clinical skills learnt during residency training between 20th and 21st century trained ophthalmologists. Ophthalmologists trained in 21st century were better exposed to automated perimetry, fundus photography, fluorescein angiography, OCT, +90/+78 D fundus evaluation, A- and B-scan ultrasonography, indirect ophthalmoscopy, and applanation tonometry. However, exposure to pediatric visual acuity testing and orthoptic evaluation was areas that were desired by the respondents. Clinical skills such as refraction, diplopia charting, and synoptophore use were perceived to be taught less by 21st century trained ophthalmologists compared to their 20th century trained counterparts. While Nd: YAG laser capsulotomy and retinal laser exposure have increased, the same did not feature for YAG iridotomies. While (52.6%) 20th century trained reported being taught contact lenses during residency training, only 152/531 (28.6%) 21st century trained ophthalmologists reported the same.

Table 5 compares the surgical training across generations of ophthalmologists. ICCE had become uncustomary, and manual SICS and Phaco were the most common cataract surgeries taught. However, there was a considerable variation in the country across programs (range 0–>25 or 0–>100 in all surgeries); and this has not changed substantially over the decades in the population studied.

Table 6 compares the academic and research inputs given to residents in the two groups. Seminars and case presentations have remained the most popular mode of teaching postgraduate ophthalmology students. Wet laboratories, rare in the last

Table 2: Surgeries observed, assisted, performed under supervision and independently by 20th century trained ophthalmologists during their residency training

Type of surgery	Observed			Assisted			Done under supervision			Operated independently		
	Range	Mean (SD)	Median	Range	Mean (SD)	Median	Range	Mean (SD)	Median	Range	Mean (SD)	Median
ICCE	0->25	15.8 (10.9)	25	0->25	14.8 (11.2)	25	0->25	11.2 (11.1)	25	0->150	52.6 (63.5)	10
ECCE	0->25	20.4 (8.5)	25	0->25	19.3 (9.2)	25	0->25	16.4 (10.4)	25	0->150	63.9 (63.7)	43
SICS	0->25	13.1 (11.6)	10	0->25	12.0 (12.0)	9.5	0->25	10.1 (12.0)	3	0->100	44.9 (62.5)	5
Phacoemulsification	0->25	11.3 (11.6)	5	0->25	9.8 (11.1)	4	0->25	5.7 (9.8)	0	0->100	25.3 (53.3)	0
Trabeculectomy	0->25	16.7 (9.5)	25	0->25	14.5 (10.1)	11	0->25	8.1 (9.8)	3	0->100	25.5 (45.9)	5
Strabismus	0->25	14.0 (10.3)	12	0->25	11.8 (10.4)	10	0->25	5.8 (8.8)	0	0->100	13.4 (31.2)	0
Pterygium	0->25	19.6 (8.9)	25	0->25	17.6 (9.5)	25	0->25	13.7 (10.2)	10	0->100	41.2 (50.8)	20
Dacrocystectomy	0->25	15.4 (9.5)	15	0->25	13.8 (9.6)	10	0->25	10.8 (9.7)	8	0->100	35.2 (49.9)	11
Dacrocystorhinostomy	0->25	16.1 (9.7)	25	0->25	14.8 (9.9)	14	0->25	11.0 (10.1)	8	0->100	29.3 (43.0)	11
Chalazion	0->25	19.5 (8.5)	25	0->25	17.2 (10.1)	25	0->25	15.2 (10.5)	25	0->100	61.7 (51.9)	35
LASIK & Refractive	0->25	3.5 (7.6)	0	0->25	2.4 (6.7)	0	0->25	1.1 (4.3)	0	0->100	4.3 (22.2)	0
Retinal detachment	0->25	12.2 (10.3)	10	0->25	10.0 (10.4)	5	0->25	2.9 (6.8)	0	0->100	5.9 (23.2)	0
Vitrectomy	0->25	10.4 (10.9)	5	0->25	8.7 (10.7)	3	0->25	3.2 (7.2)	0	0->100	5.7 (20.0)	0
Keratoplasty	0->25	12.6 (10.6)	10	0->25	11.3 (11.0)	7.5	0->25	5.3 (8.7)	0	0->100	9.8 (24.6)	0
Eyelid surgery	0->25	14.9 (9.7)	15	0->25	14.2 (10.1)	12	0->25	8.1 (9.5)	5	0->100	24.7 (41.9)	6
Ocular emergencies	0->25	18.7 (9.0)	25	0->25	16.7 (9.8)	25	0->25	12.7 (10.3)	10	0->100	48.2 (59.0)	18

The range reported by the respondents for observed, assisted and operated under supervision for all the type of surgeries was 0->25. The reported range for all the types of surgeries performed independently by the respondents was 0->100

century, have become more popular in the 21st century. Tables 7 and 8 compare the clinical skills and surgical experience gained by the residents in the 20th and 21st century trained groups across the different teaching institutes.

Table 3: Comparing demographics between 20th and 21st century trained ophthalmologists in this study

	Senior	21st century trained
Age: Mean (Std. dev, range)	49.2 (SD 8.7, range 37-84)	32.6 (SD 4, range 24-56)
Age (median)	47 years	32 years
Gender Male	245 (76.6%)	325 (61.2%)
Degree		
MS	107 (66.6%)	299 (56.3%)
MD	23 (7.2%)	31 (5.8%)
DO	81 (25.3%)	114 (21.5%)
DNB	58 (18.1%)	162 (30.5%)
1st generation doctor	97 (74.6%)	62.3%
From family of ophthalmologist	15 (11.4%)	52 (14.4%)
Married to doctor	67 (50.8%)	43.5%
Number of Children (median)	2	2
Ophthalmology as choice of career		
Top	162 (50.6%)	194 (36.5%)
Amongst top 3	119 (37.2%)	263 (49.5%)
Not amongst top 3	27 (8.4%)	74 (13.9%)
Years in practice	10-55 years	2-9 years

Discussion

The type of ophthalmic surgeries have changed over the decades, and the clinical skills have improved. However, there was a wide variation among residency programs, and the range of responses was graded from 0 to 10. Some aspects have had desirable changes. Demographically more women have entered ophthalmology. There were more second generation medical professionals and many of them chose ophthalmology as a career. Ophthalmology still remained a sought-after career option for medical graduates.

In the 21st century trained, many more come from a family of ophthalmologists as compared to the cohort trained in the last century. Medical graduates still remained the choice for spouse for both groups.

Almost all the clinical skills, teaching and exposure to investigations had improved over the past decade. The 20th century trained cohort reported only refraction, diplopia charting, and synoptophore being taught better than the 21st century trained cohort. Orthoptic evaluation, pediatric visual acuity testing and diplopia charting are skills imperative for general ophthalmologists, and this is a requirement which needs to be addressed in the teaching curriculum, even in the present day.

However, a wide range (actual reported range 0–10 for all clinical skills, investigations, and surgeries) had remained the

Table 4: Comparing the clinical skills taught during residency between 20th and 21st century trained ophthalmologists

	Mean 20th century trained	Mean 21st century trained	Median 20th century trained	Median 21st century trained	*P*
Refraction	6.5 (2.9)	5.2 (3.1)	7	5	<0.001
Slit lamp examination	6.4 (3.3)	7.2 (2.8)	7	8	0.001
Automated perimetry	3.8 (3.8)	6.2 (3.2)	3	7	<0.001
Fundus Photography	3.7 (3.7)	6.0 (3.5)	2	7	<0.001
Direct ophthalmoscopy	7.5 (2.7)	7.4 (2.8)	8	8	0.829
Pachymetry	2.5 (3.5)	4.2 (3.9)	0	4	<0.001
Orthoptic Evaluation	4.7 (3.1)	4.3 (3.1)	5	4	0.074
Fluorescein angiography	3.7 (3.6)	5.4 (3.5)	3	5	<0.001
Applanation tonometry	4.2 (3.8)	6.0 (3.7)	4	7	<0.001
Optical coherence tomography	1.7 (3.1)	4.6 (4.0)	0	5	<0.001
Gonioscopy	4.4 (3.7)	5.7 (3.4)	4	6	<0.001
A-scan biometry	4.9 (3.7)	7.0 (2.9)	5	8	<0.001
+78/+90D	3.8 (3.8)	6.8 (3.2)	3	8	<0.001
B-scan ultra-sonography	3.9 (3.7)	5.4 (3.6)	3	6	<0.001
Indirect ophthalmoscopy	4.6 (3.4)	6.2 (3.3)	4	7	<0.001
Synoptophore	4.0 (3.2)	2.5 (2.9)	4	1	<0.001
Keratometry	5.6 (3.4)	6.1 (3.2)	6	6	0.039
Hess charting	4.2 (3.3)	3.2 (3.2)	4	2	<0.001
Paediatric visual acuity testing	3.0 (3.0)	3.2 (2.9)	2	2	0.094
YAG LASER capsulotomy	4.1 (3.9)	5.8 (3.6)	3	6	<0.001
Retinal LASERs	2.3 (3.3)	3.1 (3.5)	0	1	<0.001
YAG iridotomy	3.6 (3.7)	4.1 (3.7)	2	3	0.013
Exposure to eye banking	4.4 (3.7)	5.0 (3.5)	5	5	
Exposure to Community Ophthalmology	6.4 (3.2)	6.1 (3.1)	7	6	

same with both groups. Thus, while the median residency program has improved, uniformity in basic quality in residency training needs to be pursued energetically.

Cataract is still the most common cause of avoidable blindness.[16-18] Exposure to cataract surgery was adequate but not uniform. ICCE had become a surgery of the past and manual SICS was the most common cataract surgery taught presently. Glaucoma surgeries in residency training programs showed a decline, even though it is a significant cause of blindness.[19] Better pharmacological agents and their easier availability may be a reason for the overall decrease in glaucoma surgeries.[20,21] However, learning the correct technique of filtration glaucoma surgery is essential in a residency program.[22] Pterygium excisions, sac surgeries, and eyelid surgeries had declined in number in residency training. Less outdoor work, use of protective spectacles and by and large, lesser number of patients being referred to the teaching hospitals could be possible causes. The median for strabismus surgeries, retinal detachment surgery, vitrectomy, and keratoplasty was zero for both groups. Both independent surgeries and surgeries performed under supervision were less. Strabismus, corneal, and retinal diseases are significant contributors to ocular morbidity and visual impairment.[23]

Table 5: Comparing surgical skills taught during residency between 20th and 21st century trained ophthalmologists, by comparing the number of surgeries performed independently during the residency

Type of surgery	20th century trained		21st century trained	
	Mean	Median	Mean	Median
ICCE	52.6 (63.5)	10	3.0 (14.9)	0
ECCE	63.9 (63.7)	43	39.9 (53.2)	18
SICS	44.9 (62.5)	5	75.3 (64.4)	55
Phacoemulsification	25.3 (53.3)	0	30.0 (52.6)	1
Trabeculectomy	25.5 (45.9)	5	4.0 (14.9)	0
Strabismus	13.4 (31.2)	0	1.4 (4.9)	0
Pterygium	41.2 (50.8)	20	31.5 (43.2)	15
DCT	35.2 (49.9)	11	20.3 (38.1)	4
DCR	29.3 (43.0)	11	11.7 (26.2)	2
Chalazion	61.7 (51.9)	35	46.4 (48.3)	30
LASIK and Refractive	4.3 (22.2)	0	1.5 (12.2)	0
Retinal detachment	5.9 (23.2)	0	1.5 (12.5)	0
Vitrectomy	5.7 (20.0)	0	3.1 (17)	0
Keratoplasty	9.8 (24.6)	0	5.2 (17.8)	0
Eyelid surgery	24.7 (41.9)	6	8.6 (18.9)	2
Ocular emergencies	48.2 (59.0)	18	41.7 (52.4)	20

Eye bank training had improved to an extent. The Medical Council of India has made it mandatory for each medical college to have an eye bank.

Diabetic retinopathy is increasing as a cause of blindness and visual impairment.[24,25] The resident's exposure to various modalities to manage this disease (OCT, fundus photography, lasers) has improved over time; but the exposure was uneven across the different programs in the country.

The "declared curricula" earlier and now were guidelines about the topics and subject matter to be covered.[1,2] They were not explicit about the details of the clinical, surgical, and research skills that a resident should master during the training unlike the competency standards set in the United States of America.[13] The system leaves a lot to the residents' initiative. They are expected to learn by observing and following their teachers as it was in the ancient 'Gurukul' times.[26]

Mid-term assessments were rare. Exit examinations are mainly theoretical and practical examinations are based on case presentations. A robust methodology to judge the surgical skills of a passing-out resident is needed. Practical and theoretical teaching of refractive errors, the most common cause of visual impairment is of paramount importance.

Table 6: Comparing the rating of academic schedule and types of teaching activities

	Possible range	20th century trained			21st century trained		
		Reported range	Mean (SD)	Median	Reported range	Mean (SD)	Median
Academic schedule							
Academic schedule: Expert faculty	0-10	0-10	6.5 (2.8)	7	0-10	6.4 (2.7)	7
Academic schedule: Residents	0-10	0-10	6.2 (3.7)	7	0-10	5.9 (3.1)	6
Academic schedule's management	0-10	0-10	4.3 (3.7)	4	0-10	4.6 (3.5)	4
Types of academic activities							
Academic schedule: Didactic lectures	0-4	0-4	2.2 (1.4)	2	0-4	2.2 (1.4)	2
Academic schedule: Seminar	0-4	0-4	2.7 (1.1)	3	0-4	3.2 (1.1)	3
Academic schedule: case presentation	0-4	0-4	3.1 (1.0)	3	0-4	3.2 (1.0)	3
Academic schedule: Journal club	0-4	0-4	2.1 (1.4)	2	0-4	2.2 (1.1)	2
Academic schedule: Wet lab	0-4	0-4	1.0 (1.3)	0	0-4	1.3 (1.4)	1
Academic schedule: all of the above (Overall)	0-4	0-4	2.4 (1.1)	2	0-4	2.5 (1.1)	3
Dissertation							
Level of supervision	0-10	0-10	5.7 (3.1)	6	0-10	5.9 (3.1)	6
Infrastructure for dissertation	0-10	0-10	6.1 (3.0)	6	0-10	6.4 (3.1)	7
Value added by dissertation	0-10	0-10	6.1 (3.1)	7	0-10	6.2 (3.7)	7

Table 7: Comparing the clinical skills taught to 20th and 21st century trained ophthalmologists depending on the type of institution in which residency raining was completed. The possible range for each response was 0-10

	20th century trained												
	Government Medical College			Non-Government Institute			Private Hospital			Private Medical College			*P*
	Min	Max	Median	Min	Max	Median	Min	Max	Median	Min	Max	Median	
Refraction	0	10	7	1	10	8	4	10	9	2	10	5	0.172
Slit-lamp examination	0	10	7	2	10	9.5	2	10	10	0	10	5	0.012
Direct Ophthalmoscopy	0	10	8.5	0	10	8	5	10	8	3	10	7	0.683
Orthoptic evaluation	0	10	5	0	10	5	1	9	8	0	9	3	0.029
Applanation tonometry	0	10	3	0	10	9	1	10	10	0	10	3.5	<0.001
Gonioscopy	0	10	3	0	10	8.5	2	10	10	0	10	3	0.002
+78/+90 D fundus evaluation	0	10	2	0	10	8	0	10	10	0	10	2.5	<0.001
Indirect ophthalmoscopy	0	10	4	1	10	9	3	10	10	0	10	3	<0.001
Keratometry	0	10	5	0	10	7	8	10	9.5	0	10	6	0.049
Pediatric visual acuity testing	0	10	2	0	10	4.5	0	10	8	0	9	2	0.012
Automated Perimetry	0	10	2	0	10	8	0	10	9	0	10	5	<0.001
Fundus photography	0	10	2	0	10	7	0	10	10	0	10	3	0.001
Pachymetry	0	10	0	0	10	6	0	10	10	0	10	0.5	<0.001
Fluorescein angiography	0	10	2	0	10	7	0	10	10	0	10	3	0.001
Optical Coherence Tomography	0	10	0	0	10	1	0	10	7	0	10	0	0.005
A-scan biometry	0	10	5	0	10	7	0	10	10	0	10	5	0.011
B-scan ultrasonography	0	10	3	0	10	8	0	10	10	0	10	2	<0.001
Synoptophore	0	10	4	0	10	4	0	10	4	0	8	2	0.288
Hess diplopia charting	0	10	4	0	10	5	0	10	5	0	9	2	0.475
YAG LASER capsulotomy	0	10	3	0	10	7	0	10	10	0	10	1	0.001
LASER retinal procedures	0	10	0	0	10	6	0	10	9.5	0	10	0	<0.001
YAG LASER Iridotomies	0	10	2	0	10	5.5	0	10	10	0	10	1	0.003
	21st century trained ophthalmologists												
Refraction	0	10	5	0	10	4	0	10	5	0	10	5	0.033
Slit-lamp examination	0	10	7	1	10	9	1	10	10	1	10	7	<0.001
Direct Ophthalmoscopy	0	10	9	0	10	7	0	10	8	1	10	8	0.189
Orthoptic evaluation	0	10	4	0	10	4	0	10	7	0	10	2.5	<0.001
Applanation tonometry	0	10	5	1	10	9	0	10	10	0	10	5	<0.001
Gonioscopy	0	10	5	0	10	9	0	10	9	0	10	4	<0.001
+78/+90 D fundus evaluation	0	10	7	1	10	10	0	10	10	0	10	6	<0.001
Indirect ophthalmolscopy	0	10	6	1	10	9	0	10	10	0	10	5	<0.001
Keratometry	0	10	6	0	10	6	0	10	7	0	10	6.5	0.887
Pediatric visual acuity testing	0	10	2	0	10	3.5	0	10	4	0	10	2	<0.001
Automated Perimetry	0	10	7	0	10	7	1	10	8	0	10	5	0.003
Fundus photography	0	10	6	0	10	8	0	10	9	0	10	5	<0.001
Pachymetry	0	10	3	0	10	7	0	10	8	0	10	2	<0.001
Fluorescein angiography	0	10	5	0	10	6	0	10	8	0	10	4	<0.001
Optical Coherence Tomography	0	10	3	0	10	5	0	10	9	0	10	0	<0.001
A-scan biometry	0	10	8	0	10	7	1	10	8	0	10	8	0.487
B-scan ultrasonography	0	10	5	0	10	5.5	0	10	9	0	10	4	<0.001
Synoptophore	0	10	1	0	10	1	0	10	2	0	10	1	0.086
Hess diplopia charting	0	10	2	0	10	4	0	10	5	0	10	1	<0.001
YAG LASER capsulotomy	0	10	6	0	10	7	0	10	9	0	10	3.5	<0.001
LASER retinal procedures	0	10	1	0	10	2	0	10	3	0	10	0	0.001
YAG LASER Iridotomies	0	10	3	0	10	5	0	10	5	0	10	1	<0.001

Table 8: Comparison of surgical training imparted depending on the type of institute where residency was done

Operated Independently	Government Medical College		Non-Government Institute		Private Hospital		Private Medical College		*P*
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Surgeries performed independently by 20th century trained ophthalmologists during their residency									
ICCE	59.0	64.9	34.7	61.0	52.5	68.5	17.2	37.9	0.007
Manual SICS	39.9	60.2	104.3	61.2	80.0	81.2	18.7	43.0	0.000
Conventional ECCE	69.8	64.2	93.5	61.8	94.0	77.0	39.2	47.6	0.139
Phacoemulsification	20.5	48.4	55.5	70.1	75.0	86.6	20.8	52.5	0.041
Trabeculectomy	26.0	46.3	32.1	49.5	10.5	11.0	17.8	45.8	0.010
Strabismus correction	15.6	34.1	11.5	22.4	2.0	4.5	0.8	2.7	0.024
Pterygium excision	42.7	50.6	52.5	60.1	65.0	77.9	12.5	15.4	0.024
Dacrocystectomy	33.3	47.0	63.8	69.6	72.8	72.7	9.9	12.7	0.033
Dacrocystorhinostomy	27.5	40.1	50.9	55.4	81.3	80.0	7.8	14.7	0.002
Chalazion incision and drainage	61.8	57.8	74.5	59.6	64.2	78.4	48.0	52.9	0.593
LASIK, refractive surgery	4.1	21.0	10.3	38.7	0.0	0.0	0.2	0.8	0.836
Retinal detachment surgery	7.0	25.9	4.0	13.6	2.0	4.5	0.3	1.1	0.303
Vitrectomy	6.4	21.9	6.3	14.8	2.0	4.5	1.0	2.8	0.836
Keratoplasty	10.4	23.8	4.8	8.8	37.5	75.0	0.1	0.3	0.054
Lid surgeries	26.5	43.0	35.3	50.1	5.0	10.0	2.2	3.9	0.001
Managing ocular emergencies	50.0	58.7	57.8	65.5	44.0	71.7	24.9	51.1	0.065
Surgeries performed independently by 21st century trained ophthalmologists during their residency									
ICCE	3.9	18.9	4.4	12.2	1.2	3.4	0.8	2.2	0.048
Manual SICS	61.7	62.0	117.2	55.1	107.6	58.1	64.3	62.5	<0.001
Conventional ECCE	32.9	46.6	64.4	63.3	62.4	63.6	27.1	46.2	<0.001
Phacoemulsification	31.1	53.3	40.0	58.4	38.1	57.6	13.0	36.9	<0.001
Trabeculectomy	4.5	16.0	6.7	23.5	2.8	7.4	1.4	4.0	0.001
Strabismus correction	1.8	5.5	0.5	1.6	1.6	5.2	0.6	3.2	0.012
Pterygium excision	29.6	38.4	50.2	58.0	29.0	50.3	27.0	37.0	0.014
Dacrocystectomy	17.7	34.0	42.0	54.3	26.6	50.5	9.9	15.3	0.045
Dacrocystorhinostomy	12.4	26.1	14.9	34.3	12.9	30.7	6.8	14.0	0.019
Chalazion incision and drainage	45.8	45.5	57.2	57.8	41.1	50.5	46.0	48.2	0.238
LASIK, refractive surgery	0.6	4.2	0.6	2.5	3.8	21.5	3.1	19.5	0.325
Retinal detachment surgery	2.6	16.4	0.3	1.3	0.1	0.6	0.0	0.1	0.029
Vitrectomy	4.0	19.5	5.0	24.4	1.3	3.7	0.2	0.8	0.036
Keratoplasty	5.6	15.3	5.2	14.8	4.0	22.1	4.8	23.3	<0.001
Lid surgeries	9.8	18.4	8.6	25.5	6.5	22.6	6.1	10.9	0.001
Managing ocular emergencies	41.9	49.5	44.0	59.1	45.9	59.7	36.6	52.3	0.101

The residency curriculum should stress on comprehensive ophthalmology.

The teaching of certain diagnostic techniques has gained importance in the past decade, but teaching of basic ophthalmic clinical skills has not shown a consistent growth. The emphasis of surgical training is mainly on cataract surgery. Some tried and tested academic techniques such as journal clubs and wet laboratories need to be popularised.

The study is limited to the respondents' responses. There may be a selection bias since respondents with extreme views (both positive and negative) about their residency training may have been more inclined to participate. The possibility of recall bias is relevant to the study. The other limitation of this study was the absence of evaluation of other pertinent skills, for example, professionalism and ethics, communication, leadership, and social accountability. However, since the entire process was voluntary (and anonymous if needed), we have for the first time a picture across decades about how residency training was being imparted.

The lack of standardization indicates the role of a strong regulatory authority for the implementation of the curriculum. The curriculum should be such that it focuses on the infrastructure, human resources and the actuality of the residents' learning. In addition, the curriculum should be "need-based;" it should establish standards, follow them. There should be a method to monitor these standards.

The role of residents as teachers and researchers needs to be emphasized during residency since senior residents make

excellent teachers.[27] These are part of competency-based residency curricula elsewhere.[13]

Conclusion

Indian ophthalmology is considered as one of the world leaders in blindness prevention and control.[28,29] It is held as a model for delivering quality eye care with low-cost innovations.[30,31] Ophthalmology is still a sought-after medical sub-specialty attracting the best of talents for postgraduation. Residency training programs have evolved considerably in the past decades, but a significant variation still exists in the Indian subcontinent, which needs to be bridged at the earliest, through a uniform and robust residency program.

Acknowledgment

The authors would like to Ramamurthy Dandapani, Debashish Bhattacharya, Barun Kumar Nayak, Karl Golnik, Santhan Gopal, Yogesh Shah, Ajit Babu Majjhi, Rishi Pukhraj, Virendra Agarwal, Ashis Bhattacharya, Namrata Sharma, Lingam Gopal, Pradeep Sharma, P Namperumalsamy, Meenakshi Yadav Dhar, G Chandrashekhar, Amod Gupta, Samar Kumar Basak, O K Radhakrishnan, Anil N Kulkarni, Tara Prasad Das.

Financial support and sponsorship

The study was commissioned by All India Ophthalmological Society, Academic and Research Committee (2014–2017).

Conflicts of interest

There are no conflicts of interest.

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