Effect on cataract surgeries outcomes performed by resident trainees with prior basic general surgery training

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Background
Ophthalmic surgery shares some similarities with general surgery in its basis as a surgery; cataract surgery, however, is in essence microscopic surgery and technically different. The current mainstream ophthalmology training curriculum does not require prior surgical experience. This study compares cataract surgery outcomes among ophthalmology trainees who possess experience of previous general surgery training than those without.

Materials and methods
Retrospective analyses were done on cataract surgeries performed in 2015–2019. Surgeon name, patient demographics, and visual acuity with refractive outcomes before and after cataract surgery data were extracted. Eyes with preoperative detectable morbidity other than cataract were excluded. The first 30 independent clear-corneal incision extracapsular cataract extractions of each trainee were included. Eyes identified were grouped into two groups, according to their surgeons with and without prior general surgery training. Statistical analyses were performed using *t* tests and χ^2 tests.

Results
A total of 180 eyes were included for analysis. Six resident trainees were included: three without any general surgery training, whereas three trainees underwent prior 6 months of basic general surgery training in a university teaching hospital. Postoperative corneal astigmatism increment was found to be 1.16 D ($P = 0.002$, 95% confidence interval, 0.46–1.86) less for cataract surgeries performed by residents with prior general surgery training. Otherwise, postoperative visual acuity improvement and complication rates were not statistically significant between the two groups.

Conclusions
Residents with previous general surgery training achieved better cataract surgery functional outcomes, in terms of postoperative corneal astigmatism but had similar visual acuity outcome. General surgery training is not a prerequisite to general ophthalmology training.

Keywords:
ophthalmology; general surgery; microsurgery; cataract; cataract extraction; clinical competence; graduate medical education; astigmatism; visual acuity; internship and residency

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Introduction

Cataract is a common cause of blindness worldwide that is amenable to surgical treatment [1]. Cataract surgery accounts for most ophthalmology surgical procedure [2,3]. Extracapsular cataract extraction (ECCE) is a microscopic surgery and technically different from general surgery, which refers to alimentary tract surgery [4–6]. The current training curriculum of ophthalmology does not require prior surgical experience [3], and ophthalmology residents with previous basic general surgery training are limited. Out of the debate on transferability of surgical skills learned from macroscopic surgery to microscopic surgery, this study is the first to compare the cataract surgeries outcomes among resident trainees with and without prior general surgery training.

Materials and methods

Patients who underwent elective cataract surgeries from 2015 to 2019 in a local regional acute eye hospital in Hong Kong were reviewed retrospectively. This hospital was one of the seven ophthalmology training centers in Hong Kong recognized by the College of Ophthalmologist of Hong Kong.

ECCE was offered to patients with dense cataract with no fundoscopic view clinically but flat retina on ultrasound B-scan during the preoperative visits. Preoperative corneal astigmatism was measured in negative cylinder by IOL Master 500 (Carl Zeiss Meditec AG, Jena, Germany), whereas axial length was measured with ultrasound A-scan (Eyecubed; Ellex Inc., Minneapolis, Minnesota, USA). Intraocular lens (IOL) was preselected according to patient's expected refraction individually after detailed counseling. ECCE was all performed according

to hospital standards, with superior location of clear-corneal incision wound, followed by expression of the cataract, and insertion of mono-focal EZE-60 IOL (Bausch and Lomb Incorporated, Rochester, New York, USA) in one stage. Sutures of wound were all done by 10-0 Nylon. There was no scleral tunnel creation nor conjunctival peritomy performed for all ECCE cases in the hospital.

Resident trainees started to learn cataract surgery after admission to training, beginning with lectures and practical training on simulation eyes. After passing the module end assessment in Basic Ophthalmic Microsurgical Skills Workshop organized by the Chinese University of Hong Kong, they would proceed to wet laboratory practices on pig eyes under supervision. Upon completion of training on 20 pig eyes under supervision, residents would proceed to perform steps of cataract surgery in the operating theater under direct supervision through the assistant scope. Basic ophthalmic training curriculum was in accordance with the College of Ophthalmologist of Hong Kong conjoining examinations with Royal College of Surgeons of Edinburgh (UK). Trainees with satisfactory surgical performance would start their independently surgery after 20 months of ophthalmology training and passed FRCSEd (Royal College of Surgeons of Edinburgh) Ophthalmology Part A examination. According to the hospital standard, cases selected for resident trainees were simple uncomplicated dense cataract, with clear cornea, mydriatic pupil size more than 7 mm, anterior chamber depth more than 2 mm, and without phacodonesis.

Postoperative follow-up for cataract surgeries was standardized except for cases with complications such as postoperative wound leakage, high intraocular pressure, retained nucleus fragment, loosen stitches or infiltrate, persistent anterior chamber reaction, or endophthalmitis. Schedule of postoperative follow-up was day 1, day 7, week 4, and then week 12.

Medical records were reviewed at least 4 months postoperatively by two independent ophthalmologists who did not perform or supervise any surgery on included patients. The first 30 independent clear-corneal incision ECCE cases of each trainee were included, as they reflect more accurately the difference from prior training before equalization of skills with repeated ophthalmological training. Eyes with preoperative detectable morbidity other than cataract and post-traumatic eyes were all excluded. Eyes identified were grouped into two groups, according to their surgeons with (group I) and without (group II) prior general surgery training. Data retrieved includes name of the surgeons, patient demographics, refraction, visual acuity before and after cataract surgery, and complications of surgery.

Best-corrected visual acuity tested with LogMAR scale was assessed by qualified department optometrists (registered in Part I of Hong Kong Optometrists Board register). Postoperative refraction, including sphere and corneal astigmatism, was first measured with autorefractor (Canon R-20; Canon Inc., Tokyo, Japan), followed by subjective refraction by optometrist, and documented in Diopter of negative cylinder on postoperative 12th week visit. Optometrists were blinded from the characteristics of the cases, and patients were mixed into the same queue of general eye clinic patients upon optometrists' assessment. Complications of any kinds, including intraoperative and postoperative, were all recorded. Visual acuity outcome, postoperative corneal astigmatism, and complication rate were compared.

Statistical analyses

Statistical analyses were performed by SPSS (IBM, Armonk, New York, USA), version 25, with *t* tests, x^2 tests. Extreme data outside the normal distribution were discarded.

Results

A total of six qualified resident trainees who performed cataract surgeries independently under supervision were identified in the included period. A total of 180 eyes were identified by including the first 30 independent clear-corneal incision ECCE of each trainee, and grouped according to their surgeons' prior general surgery training experience. A total of three trainees completed 6 months of postgraduate basic general surgery clinical training within university hospital general surgery units in Hong Kong with satisfactory performance. The other three trainees did not receive any surgical related training except undergraduate teachings within medical schools. Overall, 90 and 90 eyes were included under groups I and II, respectively.

Demographics of patients were similar without statistically significant difference (Table 1). Overall, lost to follow-up rate was 3.9%, without statistically significant difference between groups I and II. Baseline visual acuity for eyes that underwent ECCE was similar between groups I and II, ranging from light perception to finger counting. Overall, 92.2% of eyes got visual gain after surgery to better than or equal to 1.0 LogMAR visual acuity, without statistically significant difference across the two groups. Mean postoperative LogMAR visual acuity was 0.40 and 0.42 for groups I and II,

respectively, without statistically significant difference. Overall, 14 eyes failed to improve above this owing to underlying anisometropic amblyopia (four eyes) and macula diseases (10 eyes) (Table 2).

Postoperative corneal astigmatism before and after surgeries were in normal distribution in both groups without any outlier data. The increment of postoperative corneal astigmatism was found to be 1.16 D (P = 0.002, 95% confidence interval 0.46–1.86 D) less for those ECCE performed by residents with prior general surgery training (group I). Otherwise, there was no statistically significant difference in the complication rate across both groups.

Discussion

Postoperative cataract astigmatism affects the quality of vision despite glasses [7], and high astigmatism makes glasses prescription difficult [8]. Clear-corneal incision wound in ECCE can contribute to a significant amount of corneal astigmatism[9] and is unavoidable throughout the ophthalmology trainees' learning curve [10]. The advent of phacoemulsification technology allows smaller incisions and better functional outcomes compared with ECCE [11]. Intrinsically, cataract cases indicated for ECCE and phacoemulsification were different, ranging from preoperative planning to postoperative expectation. However, there is still a role for ECCE in the phacoemulsification era [12]. In Hong Kong, where eye care service is easily accessible, patients who underwent ECCE usually had a lack of social support or were dependent on activities of daily living, thereby delaying care of cataract until it significantly affected their daily living. In our study, ECCE was offered only to dense cataracts without fundal view on dilated fundal examination. These eyes had poor visual acuity of finger counting to light perception, and these patients all expressed difficulties to fixate for cooperating with further optical investigations, such as corneal topography. Therefore, more accurate determination of preoperative corneal astigmatism other than partial coherence interferometry (IOL Master 500) was not practical. Although high postoperative astigmatism could be contributed by a tilted IOL [13], and reduced by removal of sutures [14], only postoperative corneal astigmatism was analyzed, where tight corneal sutures directly reflect the surgeons' operation skill. Besides, patients who underwent ECCE showed poor cooperation for suture removal under slit lamp usually in our locality.

General surgery training is different from microscopic ophthalmic training; however, both involve the manipulation on sutures, which are fundamental to surgical success. Although surgical knots tying with fingers is different from instrumental knot tying under the microscope, the training on the visualization on squaring a knot and sensation of tightness of a suture equips a surgeon better no matter which way they used for suturing [15]. Appropriate tightness of a suture is essential in general surgery training; for example, in bowel anastomosis, too tight a stitch causes ischemia, whereas too loose a stitch poses a threat of anastomotic leakage [16]. The same applies to ECCE cases, when too tight a stitch causes localized flattening of cornea and resultant high astigmatism, whereas too loose a stitch poses a threat of corneal wound leakage [17].

This study demonstrated the skills on adjusting a suture tightness are transferrable from macroscopic to microscopic surgery, as residents with prior general surgery training performed better on postoperative astigmatism in ECCE surgeries. Further large-scale study, if feasible, with the involvement of a larger number of ophthalmology trainees with prior general surgery training and patients are needed to confirm the findings. Although in reality very limited ophthalmology trainees undergo prior general surgery training, training curriculum may need a change with more supporting evidence. Projecting on this finding, the suture skills learnt form general surgery should also be transferrable to corneal graft manipulation such as in penetrating keratoplasty and other types of ophthalmic surgeries requiring corneal sutures.

Concerning the suture skills training in general surgery, particularly on adjustment on suture tension and tightness, not many quantification models are

Table 1 Demographics of patients

	Group I	Group II	
n	90	90	
Age (mean±SD) (years)	75.5±12.9	74.3±9.5	P=0.49 (t test)
Age (range) (years)	47-97	53-91	
Male : female	44 : 46	43 : 47	P=0.27 (χ^2 test)

Table 2 Outcome of extracapsular cataract extraction surgeries

	Group I	Group II	
Preop VA	LP-FC	LP-FC	
Postop LogMAR VA (mean±SD)	0.40±0.25	0.42±0.25	P=0.15
Range	0-1.3	0-2.1	t test
Postop LogMAR VA >1.0	6	8	P=0.59 (χ^2 test)
Postop increase in corneal astigmatism (mean±SD) (D)	2.17±1.34	3.33±2.15	P=0.002
Range	0.00-6.25	0.50-9.00	t test
Complication rate	3	5	P=0.48 (χ^2 test)
Lost to follow-up	4	3	P=0.68 (χ^2 test)

Preop, preoperative; FC, finger counting; LP, light perception; postop, postoperative; VA, visual acuity.

available [18]. This study shines a light on the suture training for general surgery residents, such as using the animal cornea as the tissue for suture, and the resultant astigmatism as a surrogate marker for evaluating suture tension or dynamics of multiple adjacent sutures placed by trainees. For macroscopic surgical technique training, a larger eye, such as a bovine eye, may be needed for practice.

Conclusions

Residents with previous experience in general surgery training for 6 months achieved better cataract surgery functional outcomes, in terms of postoperative corneal astigmatism but had similar visual acuity outcome, in clear-corneal incision ECCE surgery. General Surgery training is not an important prerequisite to general ophthalmology trainee but may add benefit to corneal surgery training.

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Conflicts of interest

There are no conflicts of interest.

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