

# Outcome of phacoemulsification and extracapsular cataract extraction: A study in a district hospital in Malaysia

Thevi T, Reddy SC, Shantakumar C

Thevi T, Reddy SC, Shantakumar C. Outcome of phacoemulsification and extracapsular cataract extraction: A study in a district hospital in Malaysia. *Malays Fam Physician* 2014;9(2):41-7

## Keywords:

Phacoemulsification, extracapsular cataract extraction, complications, visual outcome

## Authors:

### Thevi Thanigasalam

(Corresponding author)  
M Ophthalmal  
Department of Ophthalmology,  
Hospital Sultan Haji Ahmad Shah  
Temerloh, Malaysia.  
Email: 1111thevi@gmail.com

### Sagili Chandarsekhara Reddy

MS Ophthalmal  
Department of Ophthalmology,  
Faculty of Medicine and health  
sciences, University Sultan, Zainal  
Abidin, Kuala Terengganu, Malaysia  
E-mail: profscreddy@gmail.com

### Shantakumar Chandrasekharan

B Biomed Sci.  
Unit of Biostatistics and Research  
Methodology, School of Medicine,  
University Science, Malaysia,  
Kubang Kerian, Malaysia  
E-mail: shasa1073@gmail.com

## Abstract

**Aim:** The aim of the study was to compare the outcomes of phacoemulsification (Phaco) and extracapsular cataract extraction (ECCE) in a district hospital setting.

**Methods:** A retrospective analysis was done from the medical records of the patients who underwent Phaco and ECCE in Temerloh District Hospital, Pahang state between October 2009 and September 2010. The age, gender and ethnicity of the patients, intraoperative and postoperative complications, and the best corrected visual acuity at the last follow-up visit were noted. Statistical analysis was done using Stata Software Version 11.0. The results of the two procedures were compared.

**Results:** Out of the 179 cataract surgeries performed, 146 cases were Phaco and 33 were ECCE. In our study, 82 were men and 97 were women. The age of patients ranged from 39 to 82 years; majority of the patients (71.3%) were more than 60 years of age. There was a significant association between type of surgery and outcome of visual acuity ( $p = 0.001$ ). There was no significant association between intraoperative complication and type of surgery ( $p = 0.166$ ). Postoperative complications of the surgeries were not significantly different. Good visual outcome was noted in 80.1% of eyes operated by Phaco compared to 48.5% of eyes operated by ECCE procedure.

**Conclusion:** Since the visual outcome was significantly better in Phaco compared to ECCE procedure ( $p = 0.001$ ), we recommend that Phaco equipments should be supplied in the district hospitals with adequate facilities for performing intraocular surgery.

## Introduction

Cataract is the leading cause of blindness in Malaysia<sup>1</sup> and cataract extraction is the most common type of intraocular surgery performed all over the world.<sup>2</sup> Cataract surgery has evolved from intracapsular cataract extraction (ICCE) to extracapsular cataract extraction (ECCE) and today to phacoemulsification (Phaco) that uses modern technology.

Standard ECCE involves the removal of a part of anterior capsule, manual expression of the nucleus through a large corneoscleral incision (9–10 mm) and aspiration of cortex, leaving behind the intact posterior capsule. The intraocular lens (usually rigid made up of polymethyl methacrylate) is inserted between the anterior and posterior capsule. This surgery requires local anaesthesia (facial block, retrobulbar/peribulbar/sub-Tenon injection). Since the wound is large and sutures are put to close it, there is some amount of astigmatism

after healing and thus, visual improvement takes longer time following operation.<sup>3</sup>

Phaco is the most common technique of cataract operation performed under local anaesthesia (infiltration or topical with lignocain). It involves the use of a machine with an ultrasonic hand piece equipped with a titanium or steel tip. The tip vibrates at ultrasonic frequency (40,000 Hz) and the lens material is emulsified. A second fine instrument (sometimes called as a “cracker” or “chopper”) may be used from a side port to facilitate cracking or chopping of the nucleus into smaller pieces. Fragmentation into smaller pieces makes emulsification easier as well as the aspiration of cortical material (soft part of the lens around the nucleus). After the phacoemulsification of the lens nucleus, a dual irrigation-aspiration probe is used to aspirate out the remaining peripheral cortical materials.<sup>3</sup> The surgery is performed

through a small corneoscleral/clear corneal wound (2.2–3.2 mm). The intraocular lens (acrylic or silicon) is folded and inserted using a lens injector through the small wound. Due to the small size of the wound and two level openings in the wound, no suture is required. The healing process of wound is fast and the rehabilitation time is less. There is no/very little astigmatism and thus, visual improvement is faster allowing the patient to return to work within few days. However, this procedure requires sophisticated and more expensive equipment; and the learning curve to convert from the standard ECCE to phaco procedure is long.

The National Eye Survey 1996 in which population from urban and rural areas of different states were included, revealed that cataract was responsible for 39% of the bilateral blindness and 35.9% of low vision.<sup>1</sup>

The patients suffering from cataract have diminution of vision in early stages but they remain independent in their daily activities. However, when the cataract progresses and becomes mature (opacification of whole nucleus and cortex of the lens), the vision further diminishes incapacitating them for driving and going out to get anything from the shops. Cataract is the most common cause of diminution of vision in elderly patients. Family physicians or general practitioners encounter few patients with diminution of vision in their daily practice. They are the doctors who advise the patients during their visit with visual problem. Surgery being the only treatment to improve the vision in patients with cataract; the knowledge about phaco and ECCE procedure, their complications and visual outcome will help doctors to convince their patients in a better way for acceptance of surgical treatment.

This study was done to compare the complications and visual outcome of phaco and ECCE performed in a district hospital in Malaysia.

### Methods

A retrospective study was done to compare phaco and ECCE in the Hospital Sultan Haji Ahmad Shah, Temerloh. It is one of the two (one in state headquarters, Kuantan) government funded specialist hospitals located in Temerloh district of Pahang state, providing service to a population of 1,443,365 in 2010, with an average annual population growth rate of 0.5% and an ethnic distribution of 74.9% Malays, 16.8% Chinese, 4.0% Indians and 4.3% others.<sup>4</sup>

The hospital provides health care services to the people of Temerloh district as a referral centre for Kuala Lipis, Raub, Maran, Bentong, Jerantut and Bera of Pahang state. It provides general comprehensive ophthalmology services as well as glaucoma and retinal services run by the visiting ophthalmologists from the state headquarters, Kuantan.

The data like age, gender and ethnicity of the patients, intraoperative and postoperative complications were obtained from the case folders of the patients and the National Eye Database (NED). All patients who underwent Phaco and ECCE procedures from October 2009 to September 2010 were included in this retrospective study. The best corrected visual acuity obtained after Phaco and ECCE (after refraction and subjective correction with glasses) were compared. Considering the WHO categorisation of vision figures, the best corrected visual acuity is divided into good vision (6/6 to 6/12), moderate vision (6/18 to 3/60) and poor vision (worse than 3/60).<sup>5</sup>

Refractions were performed by hospital optometrists at 6 weeks or later within 3 months if there was a need. Cases which were followed-up till 3 months were those with complications or patients who required suture removal. Combined cataract and glaucoma surgery were not done in any of the patients in our study. The outcomes were compared to see whether the type of surgery affected the complications and the final visual outcome.

The National Eye Database (NED) is a database of six registries on eye health information system which is supported by Ministry of Health Malaysia. The Cataract Registry was initiated in 2002 and has the data pertaining to patients' characteristics, intraoperative and postoperative events; and the preoperative as well as postoperative visual acuities. It is used to determine the practice pattern of cataract surgery, outcomes and factors influencing it, the occurrence of complications such as posterior capsule rupture, endophthalmitis and visual outcome. More importantly, the data are used to stimulate research on cataract.<sup>6</sup> The data were extracted from the NED by the author Thevi Thanigasalam and cleaned.

*Statistical analysis:* The numerical data values were expressed as mean and standard deviation. Categorical variables were stated as frequency (n) and percentage (%). Chi-square tests were used to determine the associations between types of surgery and outcome of visual acuity and types of surgery and intraoperative/postoperative complication. The

p value of <0.05 was taken as significant. All the analyses in the study were performed using Stata Software (Version 11.0, Stata Corp LP).

## Results

Out of the 179 cataract surgeries performed during the study period, 146 surgeries were phacoemulsification (Phaco) and 33 cases were extracapsular cataract extraction (ECCE). In our study, majority of the patient were in the age group of 61–70 years (38%, 68/179) (Table 1). The mean age of patients who

underwent Phaco and ECCE were 65.6 and 64.4 years respectively. There were more women (55.5%, 81/146) in the Phaco group while men (51.5%, 17/33) were more in ECCE group. Majority of the patients in our study were Malays (55.9%, 100/179).

There was a significant association between type of surgery and outcome of visual acuity ( $p = 0.001$ ). Majority of the patients who underwent phaco had good visual outcome (80.1%, 117/146) compared to ECCE (48.5%, 16/33) (Table 2).

**Table 1.** Characteristic of patients who underwent phacoemulsification (Phaco) and extracapsular cataract extraction (ECCE) operations (n = 179)

Characteristics	Phaco n (%)	ECCE n (%)	Total n (%)
<b>Age group (years)</b>			
≤40	1 (0.7%)	1 (3.0%)	2 (1.1%)
41– 50	11 (7.5%)	0 (0.0%)	11 (6.1%)
51– 60	26 (17.8%)	12 (36.4%)	38 (21.2%)
61– 70	55 (37.7%)	13 (39.4%)	68 (38.0%)
71– 80	50 (34.2%)	6 (18.2%)	56 (31.3%)
>80	3 (2.1%)	1 (3.0%)	4 (2.2%)
<b>Gender</b>			
Male	65 (44.5%)	17 (51.5%)	82 (45.8%)
Female	81 (55.5%)	16 (48.5%)	79 (54.2%)
<b>Ethnicity</b>			
Malay	80 (54.8%)	20 (60.6%)	100 (55.9%)
Chinese	47 (32.2%)	8 (24.2%)	55 (30.7%)
Indian	19 (13.0%)	5 (15.2%)	24 (13.4%)

**Table 2.** Association between the type of surgery and the outcome of visual acuity (n = 179)

Visual acuity	Phaco (n = 146) n (%)	ECCE (n = 33) n (%)	Total n (%)	P value
Good vision	117 (80.01%)	16 (48.5%)	133 (74.3%)	
Moderate vision	25 (17.1%)	16 (48.5%)	41 (22.9%)	
Poor vision	4 (2.07%)	1 (3.0%)	5 (2.8%)	

Posterior capsule rent (PCR) was seen in 9.1% of patients undergoing ECCE compared to only 1.4% of patients undergoing Phaco. Vitreous loss was seen in 6.1% in ECCE, but not seen in Phaco (Table 3). There was a significant association between type of surgery and the occurrence of PCR ( $p = 0.044$ ) and vitreous loss ( $p = 0.033$ ). However, there was no significant difference between the types of surgery and zonular dehiscence ( $p = 0.561$ ), or central corneal oedema, ( $p = 1.000$ ). There were more intraoperative complications

in ECCE cases (15.2%, 5/33) compared to Phaco cases (7.5%, 11/146) (Table 4). However, there was no significant association between the occurrence of an intraoperative complication with the type of surgery ( $p = 0.166$ ). Postoperative complications were not significantly different in the two types of cataract surgeries (Table 5).

High astigmatism was seen in 1.4% (2/146) of Phaco and 3.0% (1/33) of ECCE ( $p = 0.459$ ).

in ECCE cases (15.2%, 5/33) compared to Phaco cases (7.5%, 11/146) (Table 4). However, there was no significant association between the occurrence of an intraoperative complication with the type of surgery ( $p = 0.166$ ). Postoperative complications were not significantly different in the two types of cataract surgeries (Table 5).

High astigmatism was seen in 1.4% (2/146) of Phaco and 3.0% (1/33) of ECCE ( $p = 0.459$ ).

Posterior capsule opacification (PCO) was seen in 0.7% (1/146) of Phacos but not in ECCE ( $p = 1.000$ ). Corneal decompensation was seen only in Phaco (1.4%, 2/146) but not in ECCE (3.0%, 1/33). Other complications

such as cystoid macula oedema, infective endophthalmitis, intraocular lens decentration and retinal detachment were not seen in both types of surgeries.

The best corrected visual acuity of 6/12 or better was not influenced by the postoperative complications when the two groups were compared. High astigmatism was seen in 6.9% (2/29) of phacos and 5.9% (1/17) of ECCEs ( $p = 1.000$ ). Corneal decompensation was seen in 6.9% (2/29) of Phacos but not in ECCE ( $p = 0.524$ ). There were no cases of retinal detachment, cornea decompensation, endophthalmitis or cystoid macula oedema accounting for impaired or poor visual outcome.

**Table 3.** Association between type of surgery and type of complication ( $n = 179$ )

Complication	Phaco (n = 146)	ECCE (n = 33)	p Value
Posterior capsule rupture	2 (1.4%)	3 (9.1%)	0.044
Vitreous Loss	0 (0.0%)	2 (6.1%)	0.033
Zonular dehiscence	3 (2.1%)	1 (3%)	0.561
Central corneal oedema	3 (2.1%)	0 (0.0%)	1.000

**Table 4.** Comparison between intraoperative complications and type of cataract surgery ( $n = 179$ )

Intraoperative complication	Phaco (n = 146) n (%)	ECCE (n = 33) n (%)	p Value
At least one complication	11 (7.5%)	5 (15.2%)	0.166
No complication	135 (92.5%)	28 (84.8%)	

**Table 5.** Comparison between postoperative complications and type of cataract surgery ( $n = 179$ )

Postoperative complication	Phaco (n = 146) n (%)	ECCE (n = 33) n (%)	p Value
High astigmatism	2 (1.4%)	1 (3%)	0.459
Posterior capsule Opacity	1 (0.7%)	0 (0%)	1.000
Corneal decompensation	2 (1.4%)	0 (0%)	1.000

## Discussion

There was a significant association between the type of surgery done and the final best corrected visual acuity. Patients who underwent phaco had a good visual outcome (80.1%) as compared to patients who underwent ECCE (48.5%) and was statistically significant ( $p = 0.001$ ). This was comparable to the NED data from 2002 to 2011, where 91.5% of patients who underwent phaco had good vision of 6/12 or better as compared to 83% of patients who underwent ECCE.<sup>6</sup> This was similar to the

findings in Ampang Hospital where 91.7% of their patients had a good visual outcome in Phaco compared to ECCE.<sup>7</sup> In the two randomised trials conducted at Moorfields and Oxford Eye Hospitals, it has been found that the proportions of patients achieving 6/9 or better with spectacle correction was significantly higher in the Phaco group (69%) compared to ECCE group (57%).<sup>8</sup> Better visual outcome with Phaco (80%) compared to ECCE (54%) has been reported by Khan et al.<sup>9</sup> whereas Arriaga and Lozano<sup>10</sup> reported the same as 76% and 66%, respectively. In a multicentre observational study by Loo et

al.<sup>11</sup> where three ophthalmology departments of Ministry of Health Malaysia hospitals participated, it was also found that at 3 months postoperatively, the best corrected visual acuity was better in the Phaco group (94%) compared to ECCE group (81%). Conventional extracapsular cataract surgery with intraocular lens implant costs RM 3442 (USD 905.79) and phacoemulsification with intraocular lens implant costs RM 4288 (USD 1128.42). There was no significant difference in cost effectiveness between ECCE and phaco. The cost of cataract surgery in the Moorfields and Oxford Eye Hospitals (MOH) Ministry of Health Malaysia hospital was found high due to the high overhead costs.

Posterior capsule rupture (PCR) is the commonest intraoperative complication that occurs during cataract surgery. There was a significant association between the type of surgery performed and the PCR complication ( $p = 0.044$ ). In our study, PCR occurred more often in ECCE (9.1%) compared to Phaco (1.4%). This could probably be due to the different levels and seniority of surgeons involved in the present study. Majority of phaco surgeries were done by the specialists when compared to ECCE; but junior surgeons (medical officers) perform more number of ECCE procedures than phaco surgeries. Moreover, patients with mature/hypermature cataracts were subjected to ECCE when compared to immature cataracts with lesser grades of nuclear sclerosis for phaco surgery. The higher frequency of complication rate has been supported by a study done in Aravind Eye Hospital in which the complication rate has been correlated with skill and experience of the surgeon. The intraoperative complication rate was significantly high for trainee surgeons when compared with staff surgeons experienced with both phaco and manual small incision cataract surgery.<sup>12</sup>

In a study of pseudoexfoliation, small pupil and phacodonesis, Katsimpris et al.<sup>13</sup> found a similar higher incidence of PCR in ECCE (17.0%) compared to Phaco (4.2%). On the other hand, Neekhra et al.<sup>14</sup> found a higher incidence of PCR in Phaco (9.54%) compared to ECCE (6.5%). Similarly, in a study in Hong Kong by Tso et al.<sup>15</sup> there was a higher rate of PCR in Phaco (7.7%) compared to ECCE (3.0%). Interestingly, the NED data from the year 2002 to 2011 showed that the occurrence of PCR in phaco (3.9%) was similar to the occurrence of PCR in ECCE (4.1%).<sup>6</sup>

Vitreous loss was also statistically significant ( $p = 0.033$ ) depending on the type of surgery

done. We found that 6.1% of patients had vitreous loss in ECCE but there were none in the Phaco group. According to the study done by Kothari et al.<sup>16</sup> Vitreous loss was higher in the ECCE group (8.1%) when compared to the Phaco group (5%). Similarly in the study by Katsimpris et al.<sup>12</sup> a higher rate of vitreous loss was observed in ECCE (17.0%) compared to Phaco (4.2%). On the contrary, in a study of 1400 cataract surgeries by Blomquist and Rugwani,<sup>17</sup> 53 patients who underwent phaco had vitreous loss but in ECCE only 7 patients had vitreous loss.

There was no significant difference in the complication rate between Phaco and ECCE procedures ( $p = 0.166$ ). Not much of difference was found in the complication rate between phaco (6.3%) and ECCE (9.1%) in the data of NED from 2002 to 2011.<sup>6</sup> This was similar to the other Malaysian study done by Loo et al.<sup>11</sup> He found that there was also no difference in the occurrence of intraoperative complications between ECCE (17%) and phacoemulsification (14%). Meeks et al.<sup>18</sup> found no difference in the occurrence of complications between phaco (2.5%) and ECCE (4.1%) ( $p = 0.40$ ). However, in the study of complications over 22 years in Australia by Clark et al.<sup>19</sup> it was found that complications were most common in ICCE and ECCE (2%), whereas complications were half in Phaco (0.98%) ( $p < 0.001$ ).

Postoperative complications of ECCE and Phaco were not significantly different. High astigmatism was seen in ECCE (1.4%) compared to Phaco (3.0%), but this was not statistically significant ( $p = 0.459$ ). We did not study the surgically induced astigmatism but the study conducted by Loo et al.<sup>11</sup> in Ministry of Health Hospitals showed that there were significant differences in the surgically induced astigmatism between ECCE and Phaco ( $p < 0.05$ ). Minassian et al.<sup>8</sup> also found that all of the significantly poorer results in the ECCE were due to higher level of astigmatism after surgery. Posterior capsule opacification (PCO) was seen in 0.7% of Phacos but not in ECCE ( $p = 0.634$ ). Other studies have found that the occurrence of PCO is higher in ECCE compared to Phaco. Minassian et al.<sup>8</sup> also found that the occurrence of PCO was significantly higher in the ECCE group than in Phaco group ( $p = 0.014$ ). Castells et al.<sup>20</sup> also found a higher incidence of posterior capsule opacity in ECCE compared to Phaco ( $p = 0.035$ ). A lower incidence of postoperative corneal oedema in Phaco (3.6%) compared to ECCE (7.4%;  $p = 0.016$ ) was reported by Castells et al.<sup>20</sup>



Other complications such as cystoid macula oedema, infective endophthalmitis, intraocular lens decentration, retinal detachment were seen in 17.2% of phaco and 5.9% of ECCE ( $p = 0.270$ ). Minassain et al.<sup>8</sup> also did not find any significant difference between the complications in both groups. Cystoid macula oedema (CMO) was seen in three ECCE patients and two Phaco patients ( $p = 0.68$ ) and retinal detachments were seen only in two Phaco patients. Endophthalmitis was seen in four patients out of whom three patients underwent Phaco ( $p = 0.62$ ). In our study, the postoperative complications such as high astigmatism, PCO, corneal decompensation and CMO did not significantly affect the final visual outcome. Minassian et al.<sup>8</sup> found that poorer results in the visual outcome of ECCE were due to higher levels of astigmatism.

### Limitations

There were unequal number of ECCE and Phaco (33 vs 146) surgeries in this retrospective study. In addition, surgeons of different levels and seniority were involved in this study. Intraoperative complication rate was higher in the hands of trainee surgeons.

### Conclusion

Phaco has been shown to have a better final visual outcome compared to ECCE in the District Hospital setting. However, ECCE also yields good results. All district hospitals

should have ophthalmology services for cataract surgery, so that patients do not need to travel far to be operated. The training for ECCE does not take long time and almost all ophthalmologists can do it. It can be done in a functioning operation theatre with the necessary instruments that do not cost much. However, due to better outcome with phaco, we therefore recommend that district hospitals should be provided with the Phaco machine, instruments and adequate facilities for performing intraocular surgery and the doctors and paramedics should be trained so that better eye care services can be delivered to the public.

### Conflict of interest (all authors) :

None.

### Source of funding :

None.

### Acknowledgement

We thank the Director General of Health Malaysia for granting permission to publish this article. Special thanks to the Director of Clinical Research Centre Malaysia (Dr Goh Pik Pin) and Cordinator of National Eye Database (Teng Kam Yoke). We also thank the doctors and allied health personnel of the hospital.

## References

- Zainal M, Ismail SM, Ropilah AR, et al. Prevalence of blindness and low vision in Malaysian population: Results from the national Eye Survey 1996. *Br J Ophthalmol*. 2002; 86(9):961-6.
- Eric JC, Baratz KH, Hodge DO et al. Incidence of cataract surgery from 1980 through 2004:25 year population-based study. *J Cataract Refract Surg*. 2007;33(7):1273-7.
- [http://en.wikipedia.org/wiki/Cataract\\_surgery](http://en.wikipedia.org/wiki/Cataract_surgery). Accessed August 8, 2014.
- <http://en.wikipedia.org/wiki/Pahang>. Accessed August 8, 2014.
- World Health organization (WHO). *International statistics classification of diseases and health related problems*. Tenth edition, Geneva; 1992:456-7.
- Goh PP, Mohamad AS. The 5th report of the National Eye Database 2011. <http://www.acrm.org.my/ned/cataractSurgeryRegistry.html>. Accessed August 10, 2014.
- Osita ME, Yuen SZ. The outcomes of extracapsular and phacoemulsification cataract extractions. *J Biomed Sci*. 2012;11(1):123-8.
- Minassian DC, Rosen P, Dart JKG, et al. Extracapsular cataract extraction compared with small incision surgery by phacoemulsification : A randomised trial. *Br J Ophthalmol*. 2001;85(7):822-9.
- Khan MN, Amjad AS, Muhammad AP, et al. Visual outcome phacoemulsification versus extracapsular cataract extraction. *J Medical and Dental Sciences*. 2011;17(3):29-31.
- Arriaga ME, Lozano J. A comparative study of visual acuity outcomes: Phacoemulsification vs extracapsular cataract extraction. *Invest Ophthalmol Vis Sci*. 2002;43: E-Abstract 360.c ARVO.
- Loo CY, Kandiah M, Arumugam G, et al. Cost efficiency and cost effectiveness of cataract surgery at the Malaysian Ministry of Health Ophthalmic services. *Int Ophthalmol*. 2004;25(2):81-7.
- Haripriya A, Chang DF, Reena M. Complication rates of phacoemulsification and manual small incision cataract surgery at Aravind Eye Hospital. *J Cataract Refract Surg*. 2012;38(8):1360-9.

13. Katsimpris JM, Petropoulos IK, Apostolakis K, et al. Comparing phacoemulsification and extracapsular cataract extraction in eyes with pseudoexfoliation syndrome, small pupil, and phacodonesis. *Klin Monbl Augenheilkd.* 2004;221(5):328–33.
14. Neekhra A, Trivedi HL, Todkar H. Comparative study of posterior capsule rent in cases of routine extracapsular, small incision non phaco and phacoemulsification. *J Bombay Ophthalmol Assoc.* 2002;12(1):15–8.
15. Tso MY, Lam KM, Ng ACK, et al. A retrospective analysis of risk factors for posterior capsule ruptures in cataract surgeries in a local centre. *Hong Kong J Ophthalmol.* 2004;8(1):12–4.
16. Kothari M, Thomas R, Parikh R. The incidence of visual loss and visual outcome in patients undergoing cataract surgery in a teaching hospital. *Indian J Ophthalmol.* 2003;51(1):45–52.
17. Blomquist PH, Rugwani RM. Visual outcomes after cataract surgery performed by residents. *J Cataract Refract Surg.* 2002;28(5):847–52.
18. Meeks LA, Blomquist PH, Sullicab BR. Outcomes of extracapsular versus phacoemulsification cataract extraction by beginner resident surgeons. *J Cataract Refract Surg.* 2013;39(9):1698–1701.
19. Clark A, Morlet N, Ng JQ, et al. Whole population trends in cataract surgery over 22 years in Western Australia. *Ophthalmology.* 2011;118(6):1055–60.
20. Castells X, Comas M, Castilla M, et al. Clinical outcomes and cost of cataract surgery performed by planned ECCE and phacoemulsification. *Int Ophthalmol.* 1998;22(6):363–7.