

# Visual outcome and major complications of extracapsular cataract extraction performed by resident physicians at a regional hospital in Brazil

## Abstract

Teaching extracapsular cataract extraction to residents still play a valuable role in modern cataract surgery. Considering a public hospital scenario, there are several advantages over phacoemulsification, such as cost and ability to remove very dense nuclei. Some may also consider a simpler surgery as step in teaching more elaborate techniques such as phacoemulsification.

This study analysed the visual outcomes and major surgical complications of extracapsular cataract extraction performed by resident physicians in a regional institute of ophthalmology.

In this retrospective 12-month study, 54 eyes of 54 patients underwent extracapsular cataract surgery by resident physicians. It was analysed the variables influencing visual outcomes and complications into 3 different periods, so we could compare the first cases (case 1 to 18) with the intermediate cases (19 to 36) and the latest ones (case 37 to 54). This way we did analyze the progress of residents outcomes through time. Statistical analysis was performed using the chi square test and Fisher's exact test.

Although visual results were comparable to reported series by experienced surgeons, rates of complications were slightly higher with 9,25% vitreous loss and 16,7% posterior capsule rupture in the first 54 cases of the average resident's experience. There were no significant changes in post-operative uncorrected distance visual acuity (UDVA) or corrected distance visual acuity (CDVA) outcomes during residency training. A learning curve considering when complications occur shows that extracapsular cataract surgery is a safe procedure when performed by residents even in the beginning of learning process.

**Keywords:** resident training, learning curve, extracapsular cataract extraction, surgery, visual outcomes

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## Introduction

According to The World Health Organization cataract is a major cause of severe visual impairment leading to bilateral blindness in an estimated 20 million people worldwide.<sup>1</sup> It stands as 41% of all causes of blindness in urban Brazil.<sup>2</sup> Cataract surgery is considered one of the most cost-effective intervention to restore sight.<sup>3</sup>

Many studies have examined the outcomes and complication rates associated with cataract surgery performed by residents and have concluded that, overall, the complication rates and outcomes are acceptable.<sup>1,4</sup> However, few of these studies have attempted to identify a time point during training or a surgical case number at which most residents become competent in performing extracapsular cataract extraction (ECCE). We designed a study to analyze the factors involved in major surgical complications and visual outcome of ECCE done by resident surgeons in a regional hospital. The purposes of this study were to analyze outcomes of ECCE performed by residents during their training experience and to determine a resident learning curve for this procedure.

## Methods

The following study is in accordance with the ethical standards of the Helsinki Declaration of 1975, as revised in 1983.

This is a single-centre retrospective descriptive case series involving two second-year ophthalmology residents at Santa Casa de Misericórdia de Vitória Hospital in Brazil. Data were collected for

all consecutive ECCE cases performed by residents during a 2-year academic period from January, 2016, through February, 2017. During the study period, all ECCE were performed by resident surgeons under retrobulbar anesthesia under the guidance of one experienced assistant ophthalmologist.

In ECCE, a 12–14 mm corneoscleral section was made after raising a conjunctival flap, the lens capsule opened and the lens nucleus removed without fragmentation. The manual irrigation aspiration system was then used to remove the remaining cortical matter and a 6.5 mm three piece PMMA intraocular lens was inserted into the capsular bag, and the incision closed with five or more 10-0 interrupted sutures.

For each case, the following data were gathered: demographics, nuclear sclerosis grade, ocular comorbidities, resident, duration time of procedure, intraoperative complications, pre and post operative uncorrected distance visual acuity (UDVA), pre and post operative corrected distance visual acuity (CDVA), induced astigmatism and resident case number.

High risk patients with zonular weakness, posterior polar cataracts, corneal dystrophy/pathology, uniocular patients, post-uveitic cataracts, pseudoexfoliation, patients younger than 35 years, traumatic cataracts were excluded from the study.

The recommended outcomes were split into 3 different periods, so we compared the first cases performed by residents (cases 1 to 18) with cases 19 to 36 and the last cases (cases 37 to 54). This way we could analyze the progress of residents outcomes through time.

Statistical analysis was performed using the chi square test and Fisher's exact test. For variable with more than two categories it was used the maximum likelihood ratio. Cases were excluded from analysis if there was insufficient information recorded or if the patient had preoperatively diagnosed ocular comorbidities that limited postoperative visual acuity.

## Results

A total of 62 cases were identified; of these, 54 (87%) were included in the final analysis. Eight cases (12%) were excluded because of ocular comorbidities limiting the final CDVA. Most of the excluded cases had preoperative retinal abnormalities. Mean (SD) patient age at the time of surgery was 66 years (range, 43-84 years), and 24 cases (44,4%) were male. Mean preoperative CDVA was hand motion (range, light perception to 20/100).

Mean postoperative UDVA was 20/100; UDVA was 20/100 or better in 39 cases (72,2%). Mean CDVA improved from hands motion preoperatively to 20/60 postoperatively (P.001); CDVA was 20/40 or better in 41 (75,9%) of cases. Mean cylinder postoperative was 3.36 D (range 0 to 9.00 D), it was 3.00 D or better in 34 (63%) cases.

Overall, intraoperative complications occurred in 9 cases (16,7%). These included 9 cases (16,7%) with posterior capsule tear and 5 (9,25%) with vitreous loss. Table 1 shows the factors associated with major surgical complications including gender, age, surgeon, duration time of surgery, grade of intraoperative mydriasis and nuclear sclerosis grade. p value was not significant for any of the factors analysed.

**Table 1** Analysis of possible factors involved with major surgical complications

Factors	Surgical complications				p-value
	Yes		No		
	n	%	n	%	
<b>Gender</b>					
Female	4	44,4	26	57,8	0,489*
Male	5	55,6	19	42,2	
<b>Age</b>					
< 60 years old	3	33,3	13	28,9	1,000*
≥ 60 years	6	66,7	32	71,1	
<b>Resident</b>					
1	5	55,6	28	62,2	0,723*
2	4	44,4	17	37,8	
<b>Duration time of surgery</b>					
60 minutes or less	4	44,4	27	60,0	0,472*
> 60 minutes	5	55,6	18	40,0	
<b>Pupil dilation</b>					
No	4	44,4	16	35,6	0,712*
Yes	5	55,6	29	64,4	
<b>Nuclear sclerosis</b>					
Grade 3+	4	44,4	22	48,9	1,000*
Grade 4+	5	55,6	23	51,1	
<b>Total</b>	<b>9</b>	<b>100,0</b>	<b>45</b>	<b>100,0</b>	<b>-</b>

\* Exact test of Fisher

Table 2 shows there were no significant changes in UDVA or CDVA outcomes during residency training.

**Table 2** Correlation of outcomes with different periods of residency

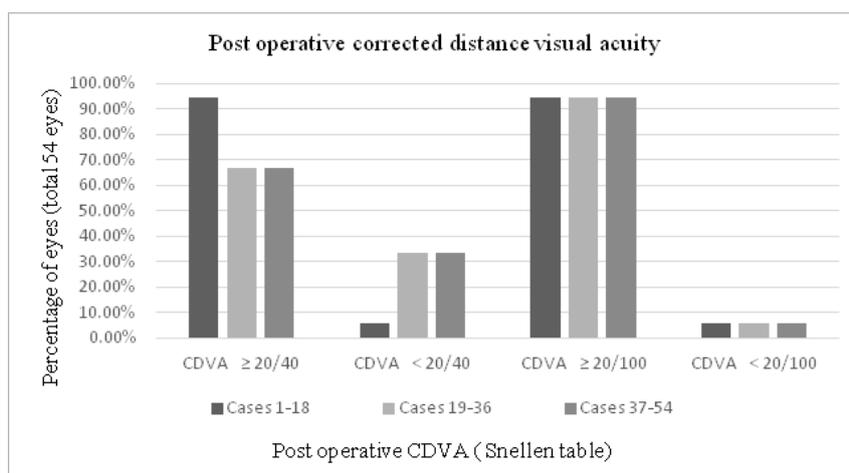
Factor	Learning curve						p-value
	Cases 1-18		Cases 19-36		Cases 37-54		
	n	%	n	%	n	%	
<b>Duration time of surgery</b>							
60 minutes or less	6	33,3 <sub>a</sub>	11	61,1 <sub>a,b</sub>	14	77,8 <sub>b</sub>	0,024
> 60 minutes	12	66,7 <sub>a</sub>	7	38,9 <sub>a,b</sub>	4	22,2 <sub>b</sub>	
<b>Surgical complications</b>							
Yes	1	5,6	4	22,2	4	22,2	0,247**
No	17	94,4	14	77,8	14	77,8	
<b>Astigmatism</b>							
3,00 D or less	11	61,1	13	72,2	10	55,6	0,574
> 3,00 D	7	38,9	5	27,8	8	44,4	
<b>UDVA postoperative</b>							
≥ 20/40	3	16,7	5	27,8	4	22,2	0,723**
< 20/40	15	83,3	13	72,2	14	77,8	
<b>UDVA postoperative</b>							
≥ 20/100	15	83,3	12	66,7	12	66,7	0,436
< 20/100	3	16,7	6	33,3	6	33,3	
<b>CDVA postoperative</b>							
≥ 20/40	17	94,4	12	66,7	12	66,7	0,079
< 20/40	1	5,6	6	33,3	6	33,3	
<b>CDVA postoperative</b>							
≥ 20/100	17	94,4	17	94,4	17	94,4	1,000
< 20/100	1	5,6	1	5,6	1	5,6	
<b>Total</b>	<b>18</b>	<b>100,0</b>	<b>18</b>	<b>100,0</b>	<b>18</b>	<b>100,0</b>	<b>-</b>

\* Different letters denote statistically significant differences between percentages

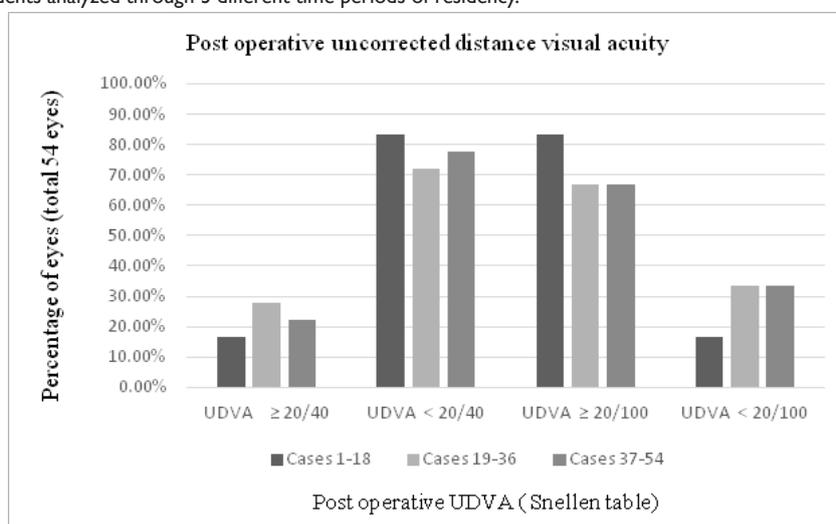
\*\* Maximum Likelihood Ratio

When resident early cases (case 1 to 18) were compared with later cases (case 37 to 54), there was a significant reduction in mean operative time (SD) (71 minutes vs 58 minutes; P.024) later in training. Mean operative time continued to decrease throughout residency training.

There were more cases with posterior capsule tears (5,6% vs 22,2%; P=.25) later in training even though it was not a significant difference. There were no significant differences in UDVA ≥ 20/100 (83,3% vs 66,7%; P=.43) or CDVA ≥ 20/40 (94,4% vs 66,7%; P=.08) later in training. The evolution of refractive outcomes are shown in figures 1 and 2.



**Figure 1** Percentages of patients eyes who achieved corrected distance visual acuity (CDVA) better than 20/40 and 20/100 (Snellen) after extra capsular extraction performed by residents analyzed through 3 different time periods of residency.



**Figure 2** Percentages of patients eyes who achieved uncorrected distance visual acuity (UDVA) better than 20/40 and 20/100 (Snellen) after extra capsular extraction performed by residents analyzed through 3 different time periods of residency.

## Discussion

Nowadays there is a growing tendency to teach phacoemulsification to residents with no previous ECCE experience.<sup>5</sup> Despite these evolutions, some residency programs still not having a formal cataract surgery training curriculum.<sup>5</sup> Nevertheless, there may be advantages in teaching the resident to master cataract surgery in a gradual manner.

The first steps would occur in a simulation environment, either virtual with the use of available technologies or with the classic wet-lab with eyes of pigs, aiming mainly to improve the resident's manual dexterity.<sup>6,7</sup>

Cataract surgery has a peculiar learning curve, so it would be interesting for the next steps to occur with a initial simpler surgery that require a lower learning curve, in the case ECCE so that, finally, the already more confident resident and more skilled, with maturity to overcome possible complications, put their abilities into practice in phacoemulsification training.

In this study we have shown that ECCE were done by resident doctors, with no prior surgical experience, with good visual results and low complication rate.

Age, gender, grade of nuclear sclerosis, grade of pupil dilation and diferent residents performing surgery did not appear to significantly affect the complication rate. This results are consistent with other studies.<sup>8</sup> Browning DJ et al reported a 9 % vitreous loss and 14% posterior capsular rate in the first 25 cases of the average residents experience with extracapsular cataract extraction.<sup>9</sup> Meeks LA et al reported a 2.5% complication rate with phacoemulsification performed by beginner resident primary surgeon and 4.1% complication rate with ECCE.<sup>10</sup>

A number of studies reporting visual outcome and complications of phacoemulsification done by residents have been reported in literature, but very few concerning extracapsular extraction.<sup>11-15</sup>

When we compared de outcomes of the first 18 cases of extracapsular cataract extraction performed by residentes with later ones we found a slightly lower rate of complications. Probably because at the beggining the resident physicians suffer substantial stress and there is a tendence of more intervention of the attending staff, especially during early cases. As the time passes by, the resident could adventure through more difficult cases with less intervention of their staffs. We can also show in this study, as the resident becomes

more experienced, we observe a decrease in the duration of the surgery.

Overall, most eyes achieved 20/40 or better CDVA after resident extracapsular cataract extraction. These results compare favorably with those of previous reports. Straatsma BR et al found resident performing extracapsular surgery achieved 20/40 or better final visual acuity in 88% of eyes; faculty surgery achieved 20/40 or better in 89%.<sup>16</sup>Sappenfield DL et al reported that in 94% of the ECCE cases done by residents, patients without preexisting eye disease achieved 20/40 or better vision.<sup>17</sup> We have found consistent visual acuity outcomes throughout residency training, with no significant trends over time.

Residency training programs should provide residents with a balanced clinical and surgical experience to optimally prepare them for autonomous practice. The main point is: how can residency programs best divide their time?

Research shows that there is a discrepancy between the number of surgeries performed by residents and their perception of the number needed to master these surgeries. In addition, phacoemulsification and non-phaco ophthalmologic surgeries, including ECCE are often neglected in residence programs.<sup>18,19</sup>

It is up to the preceptors involved in training these residents to seek feedback mechanisms to better answer the question: what is the best way to teach cataract surgery? We have strong belief that resident skills continue to improve through time and many programs should try to find ways to maximize their residents' surgery volume.

## Conclusion

Extracapsular cataract extraction can be taught safely and effectively to residents with no surgery experience as a primary surgeon.

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