

# Senior resident phacoemulsification learning curve

## *Curva de aprendizado do residente de terceiro ano em facoemulsificação*

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### ABSTRACT

**Purpose:** To analyse the outcomes of surgeries performed by senior residents during the learning curve related to intraoperative complications and staff interventions. **Methods:** Prospective study of phacoemulsification surgeries performed by senior residents (3<sup>rd</sup> year) in the first three months of experience with this technique at the HC FMUSP. Intraoperative complications and requirement of staff interventions were measured. **Results:** 261 surgeries were included. 30 cases of intraoperative complications were noted (11.54%). Major complications, that could affect surgical final results, as posterior capsule rupture and vitreous loss, had an incidence rate of 8.05% and 6.13%, respectively. Surgery was converted to cataract extracapsular extraction in 3 cases and 2 cases required pars plana posterior vitrectomy. Staff intervention was required in 11 cases (4.22%), most of them on the first 40 surgeries. **Conclusion:** With proper training and supervision, senior residents can achieve an acceptable complication rate. Adequate supervision is crucial to guarantee, good surgical outcomes, specially on the first 40 cases, that presents greater complications rates.

**Keywords:** Cataract extraction/education; Learning; Inservice training; Ophthalmologic surgical procedures/education; Internship and residency

### INTRODUCTION

Cataract surgery is the most common surgical procedure performed around the world, which reflex the fact that cataract is the first cause of blindness in the world. Population aging is making the needs for cataract surgery raise exponentially around the world<sup>(1)</sup>.

Residency curriculum reflects this fact. Cataract is the core procedure for training residents. Nowadays, phacoemulsification cataract surgery has become the preferred technique, because of its safety, faster recovery and reproducibility<sup>(2)</sup>.

There are some issues on when to start the training in phacoemulsification surgery. On the one hand, it is desirable to the surgeon to have previously experience in micro and intraocular surgery. On the other hand, up to 10% of the residents may experience troubles in developing surgical skills<sup>(3)</sup> and the later the training, less the time to specially training and supervise distressed surgeons.

Learning process complications are a point of major concern, due to the concernment with patients safety<sup>(4)</sup>. The learning curve of phacoemulsification performed by residents shows a higher number of complications<sup>(5-6)</sup> in the first cases, that decreases while experience increases. Thereafter, complications rates are considered acceptable, with good visual results<sup>(4,7-10)</sup> in the long term.

Study carried out at Department of Ophthalmology - Clinical Hospital of University of São Paulo School of Medicine - USP.

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In the cataract surgery teaching program of the Department of Ophthalmology of Clinical Hospital of University of São Paulo School of Medicine (HC FMUSP), cataract surgery by phacoemulsification technique is performed by senior residents (3<sup>rd</sup> year), who have fairly experience in microsurgery and intraocular surgery by performing first wet labs and other procedures as part of the curriculum (at least 50 extracapsular cataract extraction and 20 pterygium excision with conjunctival autograft), besides watching more than 100 phacoemulsification procedures. This method is similar to the preferred practice pattern in resident-performed cataract surgeries of the United States residency programs<sup>(2)</sup>.

Resident-performed cataract surgeries have a high potential for complications. Factors that can predict complications are: dense / white / mature / brunescant cataract, nuclear grading 1+, high refraction errors (eyes >27 mm or <20 mm), zonule weakness, pseudoexfoliation, posterior synechiae, shallow anterior chamber, corneal cloudiness, previous surgery, severe patient anxiety, inability to lie flat<sup>(11-12)</sup>, polar posterior cataract<sup>(13)</sup>, traumatic cataract and first 80 phacoemulsification surgery<sup>(10)</sup>. Attention must be paid to preoperative patient selection. Such cases should not be assigned to training surgeons.

The aim of this study is to report the phacoemulsification learning curve of senior residents. Intraoperative complications and requirement of staff interventions were measured in the first 3 months of experience of phacoemulsification cataract surgery technique.

## METHODS

A prospective study was conducted in the outpatient surgical room of the HC FMUSP in the 3 first months of residents phacoemulsification learning curve, between May/08 and July/08. All resident-performed cataract surgeries that did not meet any exclusion criteria: previous surgery, "special" cataracts (traumatic cataract, polar posterior cataract, total cataract, etc), another ocular disease, like glaucoma, uveitis and corneal opacities, insufficient mydriasis, eyes with orbital hardship and only eye were included.

The residents performed phacoemulsification with a relatively uniform technique in all cases. While patients were under topical or local (peribulbar block) anesthesia, residents performed clear cornea incisions. A continuous curvilinear capsulorhexis was performed. The lens was then phacoemulsified, usually with the "stop-and-chopp" technique. When possible, foldable acrylic intraocular lenses were inserted into the capsular bag.

Trained fellows registered the surgeries (from Monday to Thursday) performed by the residents. The residents changed the surgical day, according to a previous curriculum schedule. The registration included complications, resolution and requirement of intervention by the staff-attending doctor. Residents case number was established by asking each resident all

phacoemulsification cases performed at all facilities chronologically and then assigning each case its sequential number. Thus, the case numbers used for analysis reflect the actual experience of the individual resident performing the surgery rather than the exact sequential order of cases performed at the institution during the study period.

The data collected are registered and analyzed in a Microsoft Excel® database.

All the patients signed the informed consent form. The institution Investigational Review Board approved the study.

## RESULTS

261 surgeries were eligible for the study 14 third year residents performed the operations. Table 1 shows the number of surgeries per resident surgical experience.

Table 2 shows the absolute number of complications and the relative rates at each surgical experience group. In this study, an overall complication rate of 11.54% was found.

Table 3 shows the incidence of major complications with potential postoperative visual acuity impairment; posterior capsule rupture and vitreous loss. Table 4 shows general complications, other than the major ones.

Staff surgeon performed a direct intervention in 11 surgeries (4.23%). At the moment that the resident performed less than 40 surgeries, the rate of staff major intervention was 7.89% (9 surgeries). After that, only 2 surgeries required the supervisor direct intervention to resolve complications.

Conversion to less extracapsular extraction was indicated in 3 cases and pars plana posterior vitrectomy in another 2 cases. There were 2 cases of aphakia, one case of luxated nucleus to the vitreous cavity and 16 cases of vitreous loss.

**Table 1. Number of surgeries\* per resident surgical experience in phacoemulsification at the HC FMUSP, 2008**

Surgeries* previously performed by the resident	Number of surgeries*
0 to 40	114
41 to 80	95
81 and more	52
Total	261

\*= surgeries refers to phacoemulsification cataract surgeries

**Table 2. Frequency of complications and relative rate of complication in each group of resident surgical experience in phacoemulsification at the moment of the complication at HC FMUSP, 2008**

Surgeries* previously performed by the resident	Frequency of complications	Complication rate
0 to 40	14	12,28%
41 to 80	9	9,47%
81 and more	7	13,46%
Total	30	11,49%

\*= surgeries refers to phacoemulsification cataract surgeries

**Table 3. Frequency and rate of posterior capsule rupture and vitreous loss (major complications), distributed by the resident surgical experience in phacoemulsification at HC FMUSP, 2008**

Surgeries* previously performed by the resident	Frequency of posterior capsule rupture (rate)	Frequency of vitreous loss (rate)
0 to 40	11 (9,65%)	10 (8,77%)
41 to 80	7 (7,37%)	4 (4,21%)
81 and more	3 (5,77%)	2 (3,85%)
Total	21 (8,05%)	16 (6,13%)

\*= surgeries refers to phacoemulsification cataract surgeries

**Table 4. Frequency of complications and the number of surgeries\* previously performed by the surgeon at the moment of the complication, excluded posterior capsule rupture and vitreous loss at HC FMUSP, 2008**

Complications	Number of surgeries* previously performed by the resident
Irregular incision	1
Incision burning	1
Iris herniation	6
Irregular/incomplete capsulorhexis	6
Nucleus luxated in the vitreous	1
Lens fragment retained	2
Aphakia	2
Extensive subconjunctival hemorrhage	1
Total	20

Note: There may be more than one complication in the same surgery

\*= surgeries refers to phacoemulsification cataract surgeries

## DISCUSSION

Surgical skills learning can be one of the greatest challenges of the residency training. The trainees must develop cognitive knowledge, dexterity and tridimensional appreciation of the eye anatomy<sup>(1)</sup>. Among the eye surgeries, the phacoemulsification is considered one of the most difficult to master<sup>(1,4)</sup>.

In the HC FMUSP, a progression from theoretical readings to wet labs practice and ultimate participation in surgeries is proposed. After a theoretical course of two months, the first year resident starts a preparation for microsurgery training suture in surgical gloves at the microscope. When mastering the technique, they are authorized to make extraocular microsurgies, like pterygium with conjunctival autograft. At the end of the first year and through the second year, intraocular surgery is introduced. At least 50 extracapsular cataract extractions are performed. Throughout the year, the residents are encouraged to take some hours at the wet lab, performing some phacoemulsification surgery in pig eyes. At the end of the second year, the teaching of phacoemulsification starts. Because every step in phacoemulsification must be satisfactorily performed to easily make the next step,

the resident must master most of the steps at the time he begins the learning of phacoemulsification cataract surgery<sup>(1,4,7)</sup>. In the first surgeries, the resident has a full time supervision by a staff experienced cataract surgeon. It is recommended by the Accreditation Council of Graduate Medical Education (ACGME) at least 80 phacoemulsification cataract surgery to be done in the learning curve<sup>(10)</sup>. Most of the residents in this study achieved more than 100 surgeries in the first 3 months.

The complication rate is accepted as a parameter that reflects the phacoemulsification learning curve<sup>(14-17)</sup>. The chances of experiencing a complication decrease by 1% with each successive case during training<sup>(17)</sup>.

Few studies show the general complication rate. Most of them points out just the vitreous loss rates. The incidence of complication in resident-performed surgeries or junior trainees ranged from 1.8% to 27.4%<sup>(5-6,8-10,14-15,18)</sup>. As expected, a decreasing major complications rate was noted with the progressing experience of the surgeon. There was a small elevation in the overall complication rate after the 80<sup>th</sup> surgery, fortunately due to minor complications that do not compromise the final surgery results and could be managed by the resident himself.

The rate of major complications that can affect the final results with visual acuity loss, posterior capsule rupture<sup>(19)</sup> and vitreous loss<sup>(8)</sup> was low and coincident with other previous literature relates. There were reports of vitreous loss incidence as high as 14.7% with phacoemulsification in anterior chamber<sup>(5)</sup>. Residents are more than twice likely to lose vitreous during their first 80 cases than in their last 80 cases<sup>(10)</sup>. Vitreous loss incidence ranged from 8.77% before 40 surgeries to 3.85% after completing 80 surgeries in this study.

The percentage of phacoemulsification performed exclusively by the residents, or the completion rate, should also be considered as another critical aspect in resident surgical training. In a patient-based practice, most supervisors will try their best to avoid a high complication rate of the trainee surgeon<sup>(14)</sup>. The supervisors could prevent some dangerous or inappropriate movements, or take over the surgery if potentially serious complications occurred<sup>(14)</sup>. Their active or passive attitude in the intervention of the surgery somewhat modifies the incidence of complications and only this parameter could not reflect the real acquisition of the skills in the phacoemulsification<sup>(14)</sup>. Therefore, surgical results of the trainees should not be evaluated solely on the complication rate. The method of evaluation the learning curve by the completion rate was recently proposed and showed a rate of 44.7% of completion<sup>(14)</sup> in the United States. In this study, a very high rate of completion was found: 95.77% of surgeries being finished by the resident. The need of direct surgeon intervention was low and concentrated on the first surgeries. Before the resident had completed 40 surgeries, as presumed, the completion rates were lower, 92.11%, with the attending surgeon taking over 7.89% of the surgeries. The residents resolved most of the complications with no need of the attending staff taking over the surgery. The

number of surgeries completed in a whole by the trainees at this study was very high.

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### CONCLUSION

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In this study, major complications related to resident-performed phacoemulsification with previous experience in micro and intraocular surgery presented a low incidence. The training surgeons, without the need of staff major intervention managed most of complications. Adequate supervision is essential to guarantee good surgical results, specially in the first 40 cases, that presents greater complications rates.

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### RESUMO

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**Objetivo:** Analisar a curva de aprendizado dos residentes do 3º ano, com experiência prévia em microcirurgia e cirurgia intraocular, em facectomia por facoemulsificação relacionada às complicações peroperatórias e ao número de intervenções diretas do orientador. **Métodos:** Foi realizada análise prospectiva de cirurgias de facectomia por facoemulsificação realizadas durante os três primeiros meses de treinamento do residente do 3º ano do HC FMUSP nesta técnica. Foram registradas as complicações ocorridas durante o ato operatório e a necessidade do orientador intervir diretamente na cirurgia. **Resultados:** Foram incluídas 261 cirurgias. Destas, tiveram algum tipo de complicação peroperatória 30 cirurgias (11,54%). Complicações mais graves, com potencial para prejudicar o resultado final da cirurgia, em especial rotura de cápsula posterior e perda vítrea, tiveram um índice de 8,05% e 6,13%, respectivamente. Houve necessidade de conversão para facectomia extracapsular em 3 cirurgias e de vitrectomia posterior em 2 casos. O orientador interveio diretamente na cirurgia em 11 ocasiões (4,22%), concentradas em sua grande maioria nas 40 primeiras cirurgias. **Conclusão:** Com treinamento e supervisão adequados, taxas de complicações aceitáveis podem ser obtidas por residentes sênior no aprendizado da facoemulsificação. Adequada assistência é imprescindível para garantir o resultado das cirurgias especialmente na fase em que os residentes têm maiores taxas de complicação, correspondente às 40 primeiras cirurgias.

**Descritores:** Extração de catarata/educação; Aprendizagem; Capacitação em serviço; Procedimentos cirúrgicos oftalmológicos/educação; Internato e residência

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