Time and cost of teaching cataract surgery

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PURPOSE: To compare the differences in the time of completion of cataract surgery for residents and attending surgeons and to assign a dollar cost.

SETTING: University of Colorado teaching hospital, Aurora, Colorado, USA.

DESIGN: Comparative case series.

METHODS: Cataract cases were divided into 3 levels of difficulty for comparison. Main outcome measures were total case time (incision to patch) and degree of difficulty.

RESULTS: Nine residents and 6 attending surgeons participated in the study. Case times were collected for 324 resident cases and 319 attending surgeon cases. The mean attending surgeon case time was 25.75 minutes ± 12.32 (SD) and the mean resident case time, 46.35 ± 16.75 minutes. There was no significant difference in the degree of difficulty between resident cases and attending surgeon cases. Approximately 600 total cases were performed by 4 residents during 3 years of residency training. Taking into account the mean time of case completion for attending surgeons versus residents, the total difference in time if attending surgeons had performed 600 cataracts would be 12 360 minutes. Using a dollar cost of approximately $11.24 per minute at the institution, the cost difference was calculated to be $138 926.40.

CONCLUSION: There was a significant time and dollar cost incurred in teaching cataract surgery.

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Cataract surgery is one of the most common surgical procedures performed in the United States. Teaching cataract surgery while maintaining a high degree of patient safety remains an ongoing challenge. In addition, institutions that teach cataract surgery incur substantial costs. Most studies[1–7] have focused on outcomes as a measure of how residents compare with their more experienced colleagues in performing surgery. We recently published a detailed study of how residents progress through the learning curve of phacoemulsification.[8] As part of that effort, we recorded case times for the residents and attending surgeons who participated in the study. Using hospital-derived costs, we attempted to assign a dollar cost to teaching. The goal was to determine whether investments in time and money for classroom, wet lab, and simulation instruction before allowing residents to perform surgery might reduce costs and prove to be cost effective.

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MATERIALS AND METHODS

This study was reviewed and approved by the Institutional Review Board, University of Colorado at Denver Health Science Center. A study form for data collection was developed and reviewed by the attending surgeons (Figure 1). Data included the attending surgeon and resident performing the case; the case time, recorded from the beginning of surgery (incision) to the end of surgery (placement of a patch and shield); resident's experience, measured as a 5-level ordinal variable based on number of cases performed; whether a block was used; the degree of difficulty of the case assigned by the attending surgeon; and a proficiency score for each step of the procedure. The case time was that tracked by the operating room nurses in the medical

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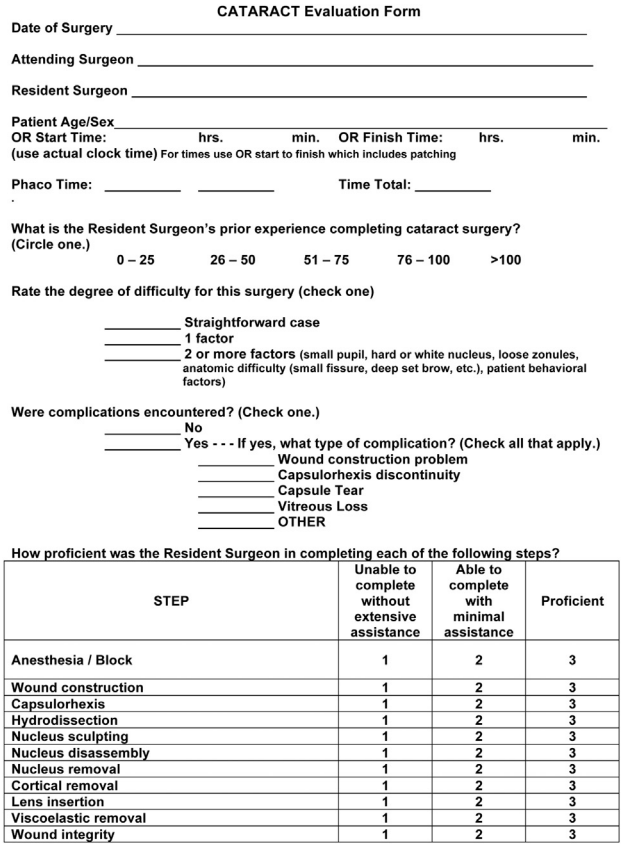

CATARACT Evaluation Form

Date of Surgery _____

Attending Surgeon _____

Resident Surgeon _____

Patient Age/Sex _____

OR Start Time: hrs. min. OR Finish Time: hrs. min.
(use actual clock time) For times use OR start to finish which includes patching

Phaco Time: _____ _____ Time Total: _____

What is the Resident Surgeon's prior experience completing cataract surgery?
(Circle one.)
0 – 25 26 – 50 51 – 75 76 – 100 >100

Rate the degree of difficulty for this surgery (check one)

_____ Straightforward case
_____ 1 factor
_____ 2 or more factors (small pupil, hard or white nucleus, loose zonules, anatomic difficulty (small fissure, deep set brow, etc.), patient behavioral factors)

Were complications encountered? (Check one.)
_____ No
_____ Yes - - - If yes, what type of complication? (Check all that apply.)
_____ Wound construction problem
_____ Capsulorhexis discontinuity
_____ Capsule Tear
_____ Vitreous Loss
_____ OTHER

How proficient was the Resident Surgeon in completing each of the following steps?

STEP	Unable to complete without extensive assistance	Able to complete with minimal assistance	Proficient
Anesthesia / Block	1	2	3
Wound construction	1	2	3
Capsulorhexis	1	2	3
Hydrodissection	1	2	3
Nucleus sculpting	1	2	3
Nucleus disassembly	1	2	3
Nucleus removal	1	2	3
Cortical removal	1	2	3
Lens insertion	1	2	3
Viscoelastic removal	1	2	3
Wound integrity	1	2	3

Figure 1. Form used to collect data.

record and included a block, if given. The attending surgeon's preference determined whether a block was given. All blocks were administered after prepping, draping, and insertion of a lid speculum. The method was a sub-Tenon block given in the inferior nasal quadrant. The case was considered to start when an incision was made through conjunctiva and Tenon capsule. Intraocular lens folding and loading into a shooter was performed by operating room nurses for all attending surgeon cases and resident cases. The degree of difficulty was based on whether the case was judged by the supervising attending surgeon to be straightforward (assigned a 1) or to have 1 or more factors making the case more difficult, such as a hard nucleus, lack of red reflex, small pupil, anatomic factors such as a deep-set eye, or behavioral issues. If at least 1 factor was present, a degree of difficulty of 2 was assigned. If 2 or more factors were present, a score of 3 was assigned. Case times and complications, such as capsule tear or vitreous loss, were noted for residents. For comparison, case times for surgeries completed without complication were collected for 4 attending surgeons with varying postgraduate experience.

Data were analyzed using SPSS software (version 17, SPSS, Inc.). Case differences in the use of a block and the degree of difficulty were compared for attending surgeons and residents using independent *t* tests and chi-square analysis, respectively. Differences in time were compared using 2×2 factorial analysis of variance with block (block versus no block) and level (attending surgeons versus residents).

To estimate a cost for teaching cataract surgery, several assumptions were made. First, the cost of an operating room minute was obtained from hospital personnel responsible for cost accounting. Next, the mean case time for residents and attending surgeons was multiplied by the total number of cases that 4 residents performed before completing their residency.

The approximate cost of attending time for supervising residents was determined. All resident cases at the institution are supervised by attending surgeons. Supervision consists of having the attending surgeon present and acting as the assistant surgeon for the entire case. A median salary for attending surgeons in the Denver area[A] was used.

Table 1. Case characteristics for attending surgeons and residents. Attending cases with complications were not included because the goal in these cases was primarily to record time.

Parameter	Attendings	Residents
Block used (%)	51	66
Difficulty level (%)		
Low	61.3	65.2
Moderate	26.6	20.9
High	12.1	13.9
Complications (%)		
Overall	NA	0.068
Serious*	NA	0.037
Mean case time (min)	25.75	46.35
Block	33.49	48.76
No block	17.70	41.63

NA = not applicable
*Serious complications included capsule tear and/or vitreous loss. There were no cases of dropped nucleus.

RESULTS

Of 643 operations, 319 were performed by attending surgeons (mean patient age 68.8 years) and 324 by residents (mean patient age 70.5 years). Resident cases were predominantly men (90.1%) because most cases were performed at an affiliated Veterans Administration hospital. Attending cases were split equally between men and women. Demographic data were not available for 34 resident cases. All cataract cases were performed using a standard technique with a clear corneal incision and predominantly a divide-and-conquer method for nucleus removal.

Table 1 shows the case characteristics for attending surgeons and residents. Attending surgeons used a block significantly less often than residents (163 versus 214) ($t = 3.80$, $P < .001$) and completed cases in significantly less time than residents (F_1 and $F_{632} = 302.68$, $P < .001$, $\eta_p^2 = .324$). Despite these differences, a chi-square analysis indicated no significant differences between attending surgeons and residents in the degree of difficulty of cases.

Residents' mean time without a block was significantly lower than the mean time when a block was used (Table 2); results indicated that on average, a