

Global Rating Assessment of Skills in Intraocular Surgery (GRASIS)

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Objective: The American Board of Ophthalmology in conjunction with the Accreditation Council for Graduate Medical Education has mandated the systematic assessment of surgical competence of ophthalmology residents at all residency programs. We present a tool complementary to the Objective Assessment of Skills in Intraocular Surgery (OASIS) to assess residents' surgical competence.

Participants: Twenty experts in resident education, including the chiefs of all ophthalmology services and the chief resident at the Harvard Medical School Department of Ophthalmology.

Methods: A 1-page subjective evaluation form was developed in conjunction with the Objective Assessment of Skills in Intraocular Surgery evaluation form to assess the surgical skills of residents. A panel of surgeons at the Harvard Medical School Department of Ophthalmology at the Massachusetts Eye and Ear Infirmary reviewed the form and provided constructive feedback.

Results: Experts' comments were incorporated, establishing face and content validity.

Conclusions: The Global Rating Assessment of Skills in Intraocular Surgery (GRASIS) has face and content validity. It can be used to assess a resident's surgical care of patients as well as a resident's surgical knowledge, preparedness, and interpersonal skills. Reliability and predictive validity will be determined at our institution. We believe the GRASIS evaluation form will be a valuable tool in conjunction with the OASIS evaluation form for assessing ophthalmology residents' surgical skills at other residency programs as well. *Ophthalmology* 2005; 112:1655–1660 © 2005 by the American Academy of Ophthalmology.

The American Board of Ophthalmology in 2002 added the assessment of residents' surgical skills to the Accreditation Council for Graduate Medical Education (ACGME)'s mandate for resident education.¹ For each medical competency, the ACGME has outlined specific learning objectives.^{1–4} The focus thus far has been on the assessment of medical skills of ophthalmology residents. Little guidance has been given on the surgical assessment of residents.

Tools for the assessment of surgical skills of the ophthalmology resident are being developed.^{1,5} Currently, assessment of surgical skill relies heavily on preceptor ratings.

At our institution, a qualitative review completed at the end of the resident's rotation was the most commonly used method to assess a resident's surgical skill. Assessment methods that are dependent on the preceptor recollection of surgical skills at the end of a rotation are well known to be problematic.^{1–3} What is needed is a concise tool to assess, both objectively and subjectively, the overall skill of the resident surgeon.

Recently, Lee and Carter presented a blueprint for residency programs to assess competence in ophthalmology residents.¹ They discussed the need for concurrent validity in assessing each competency. Specifically, they expressed the need for 2 tools to assess each competency on ≥ 3 occasions during the training period. Because subjective evaluations have many limitations, we recently presented a purely objective evaluation form to assess surgical skills.⁵ However, some subjective assessment is still helpful and necessary to evaluate a resident's surgical skill globally. We propose that the 2 tools to assess surgical competence should include objective and subjective components, such as those used in the evaluation forms Objective Assessment of Skills in Intraocular Surgery (OASIS) and Global Rating Assessment of Skills in Intraocular Surgery (GRASIS).

Thus, this article presents a detailed method for evaluating a resident's surgical competence.

Materials and Methods

The Medline and PubMed databases were searched (1970–present) to identify existing methods for evaluating ophthalmology

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The Massachusetts Eye and Ear Infirmary owns the copyright to the form developed at the Infirmary to assess surgical activities.

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Treatment of Intraocular Structures				
1 Frequently used unnecessary force or caused damage by inappropriate use of instruments	2	3 Careful handling of intraocular tissues but occasionally caused inadvertent damage	4	5 Appropriate handling of ocular structures with no damage to ocular tissue (capsule, endothelium, iris, etc.)
Time, Motion, and Energy				
1 Many unnecessary movements	2 Entered and exited eye needlessly	3 Efficient time/motion/energy but some unnecessary moves	4	5 Clear economy of movements and maximum efficiency by conserving intraocular motion and energy
Eye Position and Microscope Use				
1 Constantly required re-centration and/or re-focusing of microscope or eye	2	3	4	5 Kept the eye centered, maintained good view with microscope
Instrument Handling and use of Non-dominant hand				
1 Repeatedly makes tentative, awkward, or inappropriate movements with instruments	2	3 Competent use of instruments but occasionally stiff or awkward	4	5 Fluid moves with instruments and no awkwardness, conserving intraocular motion
Knowledge of Phacoemulsification and Vitrector equipment and instruments				
1 Frequently asked for wrong instrument or used inappropriate instrument; unaware of proper equipment settings	2	3 Knew names of most instruments and used appropriate tool for task	4	5 Obviously familiar with the instruments and equipment
Flow of Operation				
1 Frequently seemed unsure of surgical plan	2	3 Demonstrated some forward planning with reasonable progression of the procedure	4	5 Planned course of operation effortlessly from one move to next
Knowledge of Specific or New Procedure or Technique				
1 Required specific instruction at most steps	2	3 Knew all important steps of the operation	4	5 Familiar with all aspects of the operation
Interaction with Assistants/ Scrub Nurse/ Surgical Preceptor				
1 Failed to request or use assistance when needed	2	3 Appropriate use of assistants most of the time	4	5 Strategically used assistants to the best advantage at all times
Handling of Unexpected Intraocular Events				
1 Unable to recognize adverse event or unable to request proper assistance	2	3 Professional and competent identification of event. Able to request appropriate assistance	4	5 Superior independent management of event
Overall Performance				
1 Unable to perform operation independently	2	3 Competent, could perform operation with minimal assistance	4	5 Clearly superior, able to perform operation independently with confidence

Figure 1. Global Rating Scale of Operative Performance. Based on the original work developed by the Surgical Education Research Group, University of Toronto.

residents' surgical competence. Search terms included *ophthalmology residents' surgical skills evaluations*, *ophthalmology resident surgical competence*, and *ophthalmology resident's cataract surgery*. Relevant articles mainly reported resident vitreous loss rates, visual outcomes, and other intraoperative complications.⁶⁻¹¹ To our knowledge, no articles present a formal assessment tool to evaluate ophthalmology residents' surgical competence. Subsequently, we widened the spectrum of terms by looking at publications in general surgical training programs. Terms such as *assessments of surgical skills* and *competency assessments of surgical skills* were searched. Nine relevant tools, currently being used in general surgical fields, were identified: (1) operative log-books, (2) evaluations using bench or animal models, (3) morbidity and mortality data, (4) video recordings of surgical cases, (5) direct observation of procedures without criteria, (6) task-specific checklists of observed procedures, (7) global ratings of observed procedures, (8) dexterity analysis systems, and (9) assessments with virtual reality simulators.¹²⁻²³ Of these, direct observation using checklists or global ratings has shown the highest reliability and validity.¹⁴⁻¹⁶

In an effort to create more effective methods to assess surgical competence, we developed objective and subjective evaluation

tools. The objective surgical assessment tool OASIS gathers quantitative information of demographic, preoperative, intraoperative, and postoperative parameters of an intraocular surgical case. This tool has been described.⁵ The subjective evaluation tool is intended to assess the overall performance of the resident surgeon. Specifically, our goal is to create a tool complementary to OASIS with the following criteria: (1) is practical (minimally time consuming, easy to use, inexpensive to implement), (2) provides both formative feedback and summative evaluation to each resident as an incentive to improve overall skill and surgical character (bedside manner), (3) assesses the resident surgeon's professionalism in addition to surgical technique, and (4) evaluates the entire surgical process (from consent to completion of the case).

The following evaluation process led to the development of a 1-page global evaluation form. After we performed an extensive literature search as described above, we identified a validated assessment tool used in general surgery programs developed at the University of Toronto. This tool was modified for ophthalmic surgery after permission was obtained (Fig 1). A questionnaire was developed (Fig 2) to assess the tool's face validity (i.e., the extent to which the items address the vital aspects of the assessed surgical technique) and content validity (i.e., the extent to which the items

1. Are the instructions self explanatory? Yes___ No___
Comments _____
2. Is the rating scale appropriate? Yes___ No___
Comments _____
3. Does the Global Rating Scale of Operative Performance include all the factors necessary to judge operative performance? Yes___ No___
Comments _____
Specifically:
 - a. Is the "Treatment of Intra-ocular Structures" section appropriate? Yes___ No___
Comments _____
 - b. Is the "Time, Motion and Energy" section properly assessed? Yes___ No___
Comments _____
 - c. Is the "Eye Position and Microscope Use" section well depicted? Yes___ No___
Comments _____
 - d. Is the "Instrument Handling and use of Non-dominant hand" section properly portrayed? Yes___ No___
Comments _____
 - e. Is the "Knowledge of Phacoemulsification and Vitrector equipment and instruments" section fully appraised? Yes___ No___
Comments _____
 - f. Is the "Flow of Operation" section properly described? Yes___ No___
Comments _____
 - g. Is the "Knowledge of Specific or New Procedure or Technique" section appropriate? Yes___ No___
Comments _____
 - h. Is the "Interaction with Assistants/ Scrub Nurse/ Surgical Preceptor Handling of Unexpected Intraocular" section appropriate? Yes___ No___
Comments _____
 - i. Is the "Events" section well portrayed? Yes___ No___
Comments _____
 - j. Is the "Overall Performance" section appropriate? Yes___ No___
Comments _____
4. Is there anything else that should be included in the surgical assessment form (keeping in mind the goal of minimum time expenditure)? Yes___ No___
Comments _____

Figure 2. Survey to determine face and content validity of the Global Rating Scale of Operative Performance.

assess resident competency and skill associated with surgical technique). These 2 forms were sent to 22 experts in resident education, including the chiefs of all surgical services and the chief resident at the Harvard Medical School Department of Ophthalmology. Twenty experts replied. Their comments and feedback were tabulated, and the evaluation tool was modified accordingly.

Results

The surgical assessment tool consists of 10 components of operative skill that are marked on a 5-point Likert scale, with the middle and extreme points anchored by explicit descriptors to assist in the criterion of performance assessment.

All expert comments were considered, and the authors incorporated appropriate suggestions, thus establishing a level of face and content validity. Experts' recommendations included the following: to include an assessment of "preoperative planning and knowledge of the patient"; to incorporate "time, motion, and energy" with "flow of operation"; to use separate rating scales for "instrument handling" and "use of nondominant hand"; to place "flow of operation" toward the beginning of the form; and to broaden the form's applicability to periocular surgery. Specifically, some experts expressed concerns about the usefulness of this form for nonintraocular cases. One expert expressed the form's usefulness in focusing on a particular issue or concern with the resident. Six experts were concerned with the time required to complete the form. A senior expert expressed concern that such forms take time away from direct patient care. Two experts expressed their concern towards the subjective component of assess-

Table 1. Results of the Content and Face Validity Survey

	Appropriate*
Treatment of intraocular structures	20 (100%)
Time, motion, and energy	19 (95%)
Eye position and microscope use	19 (95%)
Instrument handling and use of nondominant hand	17 (85%)
Knowledge of phacoemulsification and vitrector equipment and instruments	20 (100%)
Flow of operation	19 (95%)
Knowledge of specific or new procedure or technique	17 (85%)
Interaction with assistants/scrub nurse/surgical preceptor	18 (90%)
Handling of unexpected intraocular events	19 (95%)
Overall performance	20 (100%)

*Percentage of experts who agreed with section description.

ment and giving a fair grade. One senior expert was concerned about how this form would be used in a malpractice case. One expert suggested the need to develop a separate subjective evaluation form for oculoplastic cases. The specific outcomes of this survey are noted in Table 1. Once the final tool was completed, all experts were then asked to rate the usefulness of each item in assessing resident's surgical competence on a scale of 1 to 5, with 5 being "most useful." Seventy percent (14/20) of the experts responded to this second survey in the time frame provided. The results are summarized in Table 2.

The title *Global Rating Assessment of Skills in Intraocular Surgery (GRASIS)* was finalized after we discussed it with Dr Richard Reznick at the University of Toronto, as well as other general surgical colleagues. We agreed that the global rating nature of the tool should be emphasized. The final evaluation form is illustrated in Figure 3.

This form was reviewed by the residency director and chairwoman and approved for implementation in the Comprehensive Ophthalmology Service.

Table 2. Experts' Answers to Survey on Usefulness of Each Section of the Global Rating Assessment of Skills in Intraocular Surgery (GRASIS)

	5	4	3
Preoperative planning/knowledge of patient	100% (14)		
Knowledge procedure	86% (12)	14% (2)	
Microscope use: centration	93% (13)	7% (1)	
Instrument handling	57% (8)	43% (6)	
Treatment of intraocular structures	86% (12)	14% (2)	
Flow of operation: time, motion, and energy	72% (10)	14% (2)	14% (2)
Use of nondominant hand	43% (6)	43% (6)	14% (2)
Knowledge of phacoemulsification and vitrector equipment and instruments	86% (12)	7% (1)	7% (1)
Surgical professionalism/interaction with assistants/scrub nurse	79% (11)	14% (2)	7% (1)
Handling of unexpected intraocular events/adverse events	93% (13)		7% (1)
Overall performance	79% (11)	21% (3)	

Scale: 5, most useful; 4, very useful; 3, useful; 2, may be useful; 1, not useful.

Global Rating Assessment of Skills in Intraocular Surgery (GRASIS): Global Rating Scale of Operative Performance

Resident: _____ Preceptor: _____

Circle Procedure: ClearCornea Extracap ScleralTunnel Trabeculectomy PPV PKP Other:

Beginning Middle End of Rotation

Date: _____

Preoperative Planning/Knowledge of Patient:					
1	2	3	4	5	N/A
Did not recognize or analyze potential ocular/ non-ocular risk factors of case.		Identified risk factors and had partially complete plan for them.		Identified risk factors; planned ahead appropriately	
Knowledge of Procedure:					
1	2	3	4	5	N/A
Required specific instruction at most steps.		Demonstrated some forward planning		Familiar with all aspects of procedure	
Microscope Use: Centration					
1	2	3	4	5	N/A
Constantly was asked to re-center and/or re-focus the microscope or eye			Kept the eye centered, maintained good view with microscope		
Instrument Handling					
1	2	3	4	5	N/A
Repeatedly makes tentative, awkward, or inappropriate movements with instruments		Competent use of instruments but occasionally stiff or awkward		Fluid moves with instruments, no awkwardness.	
Treatment of Ocular Structures and Other Tissues					
1	2	3	4	5	N/A
Frequently used unnecessary force or caused damage by inappropriate use of instruments		Careful handling of tissues but occasionally caused inadvertent damage		Appropriate handling of tissues and structures. Produced no damage	
Flow of Operation: Time, and Motion.					
1	2	3	4	5	N/A
Frequently seemed unsure of surgical plan Many unnecessary movements. Entered and exited eye needlessly		Knew most important steps of the operation Efficient time/motion/energy but some unnecessary movements.		Progressed effortlessly. Maximum efficiency by conserving intraocular motion and energy	
Use of Non-dominant hand					
1	2	3	4	5	N/A
Does not use non-dominant hand Or performs few, inappropriate movements		Performs few movements with dexterity at certain steps of procedure		Uses non-dominant hand with dexterity throughout the procedure	
Knowledge of Phacoemulsification and Vitrector equipment and instruments					
1	2	3	4	5	N/A
Frequently asked/ used wrong instrument; unaware of proper equipment settings		Knew names of most instruments; used appropriate settings/ tools for task		Obviously familiar with instruments and equipment	
Surgical Professionalism: Interaction with Assistants/ Scrub Nurse/ Surgical Preceptor					
1	2	3	4	5	N/A
Failed to request or use assistance when needed		Appropriate use of assistance most of the time		Strategically used assistant to the best advantage at all times	
Handling of Unexpected Operative Events/ Adverse Events					
1	2	3	4	5	N/A
Unable to recognize adverse event or inappropriate over reaction due to inability to request proper assistance		Professional and competent identification of event appropriate assistance		Superior independent management of event	
Overall Performance					
1	2	3	4	5	N/A
Unable to perform operation independently		Competent, could perform operation with minimal assistance		Clearly superior, performed operation independently with confidence	

Figure 3. Final Global Rating Assessment of Skills in Intraocular Surgery evaluation form. Based on the original work developed by the Surgical Education Research Group, University of Toronto. Extracap = extracapsular cataract extraction; N/A = not applicable; PKP = penetrating keratoplasty; PPV = pars plana vitrectomy.

Discussion

Assessment of surgical competence of ophthalmology residents is becoming an essential area of research. Since the ACGME's and American Board of Ophthalmology's mandate to develop valid and reliable tools to assess residents' surgical competence, residency programs have been investing time and funds to comply. To our knowledge, there are no published evaluation tools to evaluate ophthalmology

residents' surgical skills aside from the OASIS.⁵ It is well known in the clinical realm that current qualitative forms used by faculty may be unreliable due to grade inflation and overt subjective assessments.^{1,3,15} Direct observation is required in the training of residents during surgery and is essential in the overall assessment of the residents' surgical skill.

Although assessment of surgical competence for ophthalmology residents is a relatively new area of research,

surgical educators in general surgical fields have evaluated the validity and reliability of various assessment methods.^{14–23} Their research has shown poor reliability and validity of surgical logbooks and non-criteria-based observed surgical procedures.¹⁵ The validity of bench or animal models and simulation surgery is directly proportional to their ability to replicate the real surgical environment. Checklists, global rating scales, and dexterity analysis systems have shown good reliability. More recent studies have shown global ratings to be a better method of assessing general surgical residents than task-specific checklists.^{15–21} The global rating scale outlined in the GRASIS is defined as an analytical scoring system in which observable and measurable components of the surgical performance produce the overall performance of the surgical task.²⁴

The GRASIS developed by our service uses direct observation of residents' performance during ocular surgery. In contrast to the OASIS, in which fixed parameters such as total phacoemulsification time or the need for attending intervention indicate, in part, an objective level of competence, the GRASIS provides a broader view of how the resident–surgeon functions intraoperatively with regard to the mastery of techniques as well as general issues of professionalism. Additionally, the GRASIS can be used to provide both formative and summative feedback. For instance, in the comprehensive eye service the form has been used to provide formative feedback in which specific comments and recommendations were given to the resident on his or her performance. This provided the constructive criticism needed to help the resident improve his or her surgical technique and level of competence. Additionally, 3 GRASIS forms were submitted to the residency program director's office as a summative representation of the resident's performance at the beginning, middle, and end of the surgical rotation. Individual residency programs can use the GRASIS for either type of feedback.

A concern raised with other clinical evaluations of residents has been the expense and time involved in assessments and outcomes analysis.^{1–3} Once implemented, the GRASIS requires little time and few financial resources for the surgical preceptor to complete and discuss with the resident. On our service, we have found that a surgical preceptor familiar with the GRASIS can complete the form in <5 minutes. Follow-up discussion with the resident can vary in time. However, the GRASIS form facilitates discussion and serves as a platform to discuss methods to improve surgical skills.

Of note, the GRASIS evaluation form is not proprietary. We present this form so other residency programs may have a template of a surgical assessment form.

The GRASIS form is important in that it directly evaluates essential competencies presented by various commissions. With respect to the Pew Health Professions Commission recommendations, the GRASIS helps evaluate a resident's ability to apply knowledge of new schemes and assess a resident's ability to think critically in a surgical situation, as well as solve intraoperative problems.²⁵ Specifically, this evaluation tool helps the surgical preceptor identify which areas a resident needs improvement in. The resident is thus able to receive detailed feedback on current

skills and direct future efforts in improving weak areas. The GRASIS also allows an evaluation of a resident's overall ethical behavior and professionalism in the surgical sphere. The GRASIS evaluates a resident's readiness to operate without any assistance and, thus, practice leadership in the operating room. Finally, the GRASIS allows surgical preceptors and residents to improve continuously the quality of care that surgical patients receive by improving the transfer of surgical knowledge and surgical skills more effectively and efficiently. With regard to the ACGME and American Board of Medical Specialties, the GRASIS allows a clear assessment of (1) patients' surgical care, (2) medical and surgical knowledge, (3) practice-based learning and improvement, (4) interpersonal and communication skills, and (5) professionalism. Of note, this form is meant for internal quality control and peer review, and is confidential. It is filed in the residency program director's office with no patient identifiers, and should thus be exempt from use in malpractice cases.

Several types of instruments can be used for resident surgical skill assessment: practice-based tools (wet laboratory practice evaluations, computer-based tutorials, simulation surgery evaluations) and record-based tools (surgical logs, grand rounds presentations, resident self-review of surgical videos). However, direct observation is still the main source of a preceptor's assessment. We propose the use of structured tools to guide this direct observation assessment process. Together, the GRASIS and OASIS fulfill the specific criteria desired in surgical assessment tools.¹ These tools allow multiple assessments by multiple surgical preceptors at multiple points in time. They both have face and content validity. They are easy to complete, require little time, and are convenient. They can each be used to teach and assess the resident at the same encounter. The GRASIS and OASIS provide the qualitative and quantitative data that will lead to improved surgical technique, patient surgical care, and educational outcomes. They are linked to the explicit learning objectives of the Pew Health Professions Commission and the ACGME. The grading scale is clearly defined and has been judged appropriate and fair by the faculty. Thus, these 2 different but complementary tools can be used to assess comparative validity (direct comparison of the 2 tools to determine if similar qualitative results are obtained), interrater reliability (consistency of grading between evaluators), and concurrent validity with the OASIS (separate tools used to assess the same competency at the same time in the surgical training period).

Ultimately, one of the long-term goals in assessing residents' surgical skills is a reduction in surgical errors and improved outcomes. Currently, there has been little to no research showing a link between ophthalmic residents' overall surgical performance and patients' outcomes. Of note, we presented preliminary findings relating lower resident vitreous loss rates in surgeries attended by surgical preceptors who attend >100 resident-performed cataract surgeries per year (Ciolino J, Cremers SL, Henderson B. Attending consistency and vitreous loss rates. Paper presented at: American Society of Cataract and Refractive Surgery meeting, April, 2004; San Diego, California). Together, the OASIS and GRASIS will help identify

other factors that affect residents' intraoperative performance and postoperative outcomes.

The GRASIS and OASIS can be used at residency training programs as 2 complementary tools to assess surgical competency. Additionally, interrater reliability and concurrent validity studies will help us determine if the GRASIS can be shortened in length and still achieve the same desired level of reliability and validity.

The ACGME, American Board of Ophthalmology, and the ophthalmology community have moved to the second phase of developing assessment tools to assess the 7 proposed competencies. We hope that the GRASIS, as a complement to the OASIS, will provide a structured template for other residency programs to assess their residents and improve overall surgical outcomes.

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