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This work and its defense approved by:

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The effects of an educational workshop on performance of 4th degree perineal laceration repair

A thesis submitted to the Graduate School of
the University of Cincinnati in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE

in the department of Environmental Health, Division of Epidemiology and Biostatistics
of the College of Medicine

By

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Previous degrees: Doctor of Medicine, Bachelor of Arts (x2)

Committee Chair: Dr. Erin Haynes

Abstract

Objective

The purpose of this study is to develop a valid and reliable tool to objectively measure surgical skill necessary for repair of 4th degree perineal lacerations and then to use this tool to measure improvement

Methods

We measured baseline surgical ability and clinical knowledge of twenty-six residents (PGY-1 to PGY-4) using Objective Structured Assessment of Technical Skills (OSATS) examination as well as a written examination. The OSATS consists of a global surgical skills assessment, a procedure checklist, and a final pass / fail grade. Five weeks after our baseline evaluation, a 1.5 hour workshop was administered to approximately half of the twenty-six residents (n=14). One week after this intervention, the residents were re-examined using the same assessment tools.

Results

The OSATS demonstrated construct validity as scores on the examination increased on both the OSATS-G as well as the OSATS-C from PGY-1 through PGY-4 ($p = .001$ and $p = .041$, respectively).

Reliability indices for the OSATS were high. Eighty-one percent of the residents failed the OSATS before intervention because of failure to identify and repair the internal anal sphincter. After educational intervention, senior residents (PGY-3 + PGY-4) improved on all assessments (OSATS-G, $p = 0.41$, OSATS-C, $p = 0.004$, written examination, $p = 0.008$) and all residents passed the OSATS.

Conclusion

A valid and reliable OSATS and written examination was developed to assess surgical skills, knowledge, and judgement necessary to properly manage 4th degree perineal lacerations. Residents improved on the OSATS and the written examination after receiving a structured educational workshop.

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Table of Contents

Introduction	page 1
Materials & Methods	page 2
Results	page 5
Discussion	page 6
References	page 9
Tables	page 10
Copyright Permission	page 18
Published Article	page 20

List of Tables

Table 1:	Objective Structured Assessment of Technical Skills (OSATS) for 4th degree perineal laceration repair
Table 2:	Structured workshop for 4th degree perineal laceration repair
Table 3:	Construct Validity of OSATS
Table 4:	Construct validity
Table 5:	Reliability Indices
Table 6:	Comparison of intervention and control groups
Table 7:	Effectiveness of Educational Intervention
Table 8:	Effectiveness of Education Intervention by resident level
Table 9:	Spearman Correlation between assessment tools

List of Figures

Figure 1:	4 th Degree Perineal Laceration Anatomic Replica
Figure 2:	Layers of the 4 th degree laceration

Introduction

Up to 50% of women experience some degree of fecal incontinence after anal sphincter repair¹⁻⁴. Three-fourths of women who have been repaired after a 3rd or 4th degree tear have persistent defect in the anal sphincter musculature 15 months after a repair⁵. Most sphincter injuries are recognized at the time of delivery and the majority are repaired in the delivery suite, sometimes by a junior resident physician who is unfamiliar with the anatomy⁷. Furthermore, with the decline in forceps deliveries and reduction of resident work hours, all graduating obstetrics and gynecology residents are acquiring less experience in the repair of these advanced perineal lacerations⁸. Training and testing on inanimate life-like models may be helpful in enhancing the acquisition of technical skills for repair of these advanced perineal lacerations

In-training as well as written and oral board examinations assess cognitive knowledge and clinical judgement. Technical proficiency, however, is not easily evaluated. Case logs and faculty evaluations are imprecise and unreliable methods of evaluating physician competence. Unfortunately, most resident training programs rely on these subjective faculty assessments⁹⁻¹⁰.

The Objective Structured Assessment of Technical Skills (OSATS) is a valid and reliable method of measuring surgical skills and it has been validated for different types of procedures in both general surgery as well as in obstetrics and

gynecology¹¹⁻¹⁵. Early in its development, it was demonstrated that OSATS using bench models is equivalent to those using live animals¹². Advantages of inanimate anatomic models include availability, lower cost, portability, and obviates ethical issues involved in the use of live animals.

The purpose of this study was to develop a valid and reliable OSATS to measure surgical skill necessary for proper repair of 4th degree perineal laceration. We hypothesize that technical skills, knowledge, and judgement pertinent to these repairs will improve after a structured educational workshop. This study and its results were published in 2007 in *Obstetrics and Gynecology*¹⁶.

Materials and Methods

The OSATS consists of a global surgical skills assessment (OSATS-G), a procedure checklist (OSATS-C), and a pass/fail grade. Table 1. describes OSATS in detail. We used the original global assessment evaluation form developed by Reznick et al. to assess general surgery residents performing inguinal hernia repairs¹². The global assessment has been used by other investigators to assess surgical skills necessary for enterotomy repair, episiotomy repair, diagnostic hysteroscopy, and other procedures. We developed our own procedure checklist for 4th degree perineal laceration repair following the recommendations in Williams Obstetrics Textbook, ed. 22nd ¹⁷. Finally, we gave a pass or fail grade based on low score on the OSATS-G, failure to re-approximate any 1 of 3

anatomic landmarks evaluated by OSATS-C, or inability to complete the entire repair within the allotted 25 minutes.

The residents arrived in the testing room which contained the 4th degree laceration anatomic replica, an adjustable light, appropriate and multiple distracter sutures and instruments. The same clinical scenario was read to all of the residents, then standardized instructions were given. The examiners acted as surgical assistants, did whatever was asked of them but did not give input or assistance unless they were asked. The extent of the obstetrical laceration was not stated. Four evaluators completed the OSATS score sheets for each resident.

Twenty-six obstetrics and gynecology residents from TriHealth Hospitals, in Cincinnati, Ohio, participated in baseline assessment and re-assessment using OSATS as well as written multiple-choice examinations. Testing and re-testing were 6 weeks apart because sessions took more than 6 hours each time (7 am to 1:30 pm) and interfered with clinical duties (from 12 pm to 1:30). The chairman of the department only permitted testing and re-testing during the monthly resident education day set aside for the Division of Urogynecology and Reconstructive Pelvic Surgery. In this study, we were interested in studying the short-term effects of a workshop, thus our educational intervention was scheduled exactly one week before re-testing date. The “intervention group” which consisted of about half (n=14) of the residents from each level of training underwent a 1.5 hour workshop

(Table 2). Residents at Trihealth residency program are evenly split between two hospitals (Bethesda North and Good Samaritan). To minimize interaction between the intervention and control groups, those residents doing their rotation at Good Samaritan Hospital during our study period were assigned to the “intervention group.”

Residents repaired 4th degree laceration on commercial anatomic replica, The Sultan Anal Sphincter®, purchased from Limbs and Things, Inc. (Bristol, UK) (Fig 1 and 2.) This model comes with a replaceable perineal pad which allows approximately 24 repairs before replacement is necessary. Each model (skin, 1 perineal pad, base and clamps) costs approximately \$ 642.94. Each additional replacement perineal pad costs \$ 109.22.

This study was reviewed and approved by the Good Samaritan Hospital Institutional Review Board and funded by the Hatton Institute for Research and Education. The four evaluators underwent a 30 minute examiner orientation before the study was begun. They also participated in a pilot study in order to demonstrate high inter-rater reliability on the OSATS-C and OSATS-G (Table 5).

Statistical analyses were performed using SPSS for windows, version 14.0 (SPSS, Inc, Chicago, IL). The consistency of our tests was measured by test-retest reliability, inter-rater reliability, internal consistency reliability (Cronbach’s alpha). Construct validity is a proxy for validity, or the extent to which a test

measures what it is intended to measure. Because of ordinal measures and small group-specific sample sizes, Kruskal-Wallis and Dunn's test were used to establish construct validity. Fischer's Exact Test and t-test were used to establish similarity between control group and intervention group. Spearman's rho correlation coefficients were used to measure correlation between OSATS-G, OSATS-C and written examination scores. A p value of $< .05$ was considered statistically significant.

Results

Table 3 demonstrates a rising trend in the scores from PGY-1 to PGY-4. In table 4, construct validity is established as senior residents perform better than junior residents on the OSATS. All of our testing techniques were highly reliable (Table 5). The written examination did not demonstrate construct validity ($p = .052$), however, its test-retest reliability was high, 0.91. Eighty-one percent of all residents (35% of senior residents) failed the baseline assessment because they failed to recognize and repair the internal anal sphincter.

The control group and the intervention group did not differ in demographic characteristics or their baseline score on the OSATS (Table 6). The intervention group out-performed the control group on the written examination, OSATS-G, and the OSATS-C (see Table 7). Additionally, PGY-2, PGY-3, PGY-4 residents improved in at least one of the assessment techniques. The senior residents

improved on all assessment techniques after the intervention (Table 8). All residents passed the OSATS after intervention.

Table 9 shows Spearman's rho correlation between the different assessment techniques. There was moderate correlation between OSATS-G and OSATS-C before intervention. After intervention, both OSATS-C vs. OSATS-G as well as OSATS-C vs. written examination were strongly correlated.

Discussion

The OSATS is a valid and highly reliable assessment tool and has been used successfully with several types of surgical procedures to measure resident physician operating skill proficiency. OSATS using commercial anatomic replica allows residency programs and board examiners to test technical skill of a specific surgical procedure. It also offers the advantages of availability, portability, and cost-savings over live animals and cadavers. In our study, we demonstrated that our OSATS for fourth degree laceration repairs is both valid and highly reliable. A statistically significant rising trend in scores on both the checklist and the global assessment tools was observed as one progressed from junior to more senior level residents.

Correlations between the OSATS-G and OSATS-C as well as between the OSATS-C and written examination were high after our workshop. This suggests

that a written examination by itself, which is easier to administer and less time-consuming, may be sufficient if administered after a highly structured workshop.

Approximately 81% of all residents, comprising of 35 % of senior residents failed the OSATS because they did not recognize the existence of internal anal sphincter and made no attempt to repair it. We doubt that this occurred because of the inadequacies of our commercial anatomic replica as the internal anal sphincter layer is obvious and prominent (see Fig 1 and 2). To highlight the gravity of this issue, our residents are above national average for the number of vaginal deliveries, instrument deliveries, and 3rd/4th degree lacerations. In 2005, one of the two TriHealth Hospitals at which residents rotate had 4,401 vaginal deliveries, and 11% of these were forceps deliveries while 6% were vacuum deliveries. Residents at this hospital were exposed to four hundred and sixty one, 3rd degree, and one hundred fifty nine, 4th degree lacerations. Since the internal anal sphincter comprises 70-80% of the resting tone of the anal sphincter, it is very important to recognize and fix this structure properly. Thus a nationwide educational effort is needed to address this problem. Obstetrics is often taught by junior residents and bad habits are establish early and never corrected. Hand skills improve but concepts don't. Perhaps, a structured workshop should be administered early in the third year of residency and skills assessed before they are expected to repair 4th degree lacerations on their own or teach it to junior residents.

There are a few limitations of this study. First, because of difficulty with resident schedules and need to keep the intervention group from interacting with the control group, the intervention was not assigned by an accepted randomized method such as computer generation or random digit table. Another limitation is that sample size was small and residents were trained and tested by familiar faculty.

In this experiment, we did not study the diminution of testing effects with time or the long-term effects of our intervention. Perhaps, in several months to 2 years a follow-up study can be conducted. We also did not study the effects of varying our educational intervention. For example, one may study the effects of different types of intervention (didactic vs. video vs. self-practice).

In conclusion, we developed a valid assessment tool that was able to reliably quantify surgical skill. We were able to objectively measure improvement in surgical ability after our educational intervention.

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Table 1. Objective Structured Assessment of Technical Skills (OSATS) for 4th degree perineal laceration repair

	Criteria for evaluation	Example
global assessment (OSATS-G)	<ol style="list-style-type: none"> 1. knowledge of procedure 2. flow of operation 3. respect for tissue 4. time and motion 5. knowledge of instruments 6. instrument handling 7. use of assistants 	<p>5 points on "flow of operation"</p> <p>means "Obviously planned course of operation with effortless flow from one move to the next."</p>
procedure checklist (OSATS-C)	<ol style="list-style-type: none"> 1. extent of injury 2. anesthesia consideration 3. choice of suture and instrument 4. re-approximation of anatomic landmarks <ol style="list-style-type: none"> a) rectal mucosa b) internal anal sphincter c) external anal sphincter 5. re-evaluation of scenario 	<p>5 "✓" marks on "external anal sphincter"</p> <p>means 4-6 throws of 2.0 or 3.0 vicryl to reapproximate muscle & capsule; throws were placed in the following order: posterior</p> <p>(3 O'clock) , inferior (6 O'clock), superior, (12 O'clock), anterior (9 O'clock) and held; 3 and 6 O'clock were tied first</p>
pass / fail grade	<ol style="list-style-type: none"> 1. < 10 points on OSATS-G and / or 2. Failure to identify or repair 1 of 3 	<p>not identifying and repairing the internal anal sphincter during repair means the resident</p>

	anatomic landmarks and / or	received a "fail" grade on the OSATS
	3. not completing entire repair in 25 minutes	

Table 2. Structured workshop for 4th degree perineal laceration repair

Powerpoint didactic	Nature of intervention	Time	# of slides
used color illustrations, animation, & re-iteration of main points of each slide	review pelvic and perineal anatomy	10 min	5
	embryology of pelvic organs and perineum	4 min	3
	epidemiology	2 min	1
	review suture types and knot-tying	4 min	2
	review needle shapes / points and needle control	4 min	2
	review instrument names and proper handling	4 min	2
	review surgical concepts	4 min	3
	review definitions of 3rd and 4th degree laceration	2 min	2
	review proper repair of 4th degree laceration	20 min	7
	complications of 4th degree repair	4 min	2
	review risk factors for and prevention strategies	2 min	1
		60 min	30
practice session	4th degree anatomic replica and appropriate instruments and sutures were provided; residents practiced repair while being coached	30 min	

Table 3. Construct Validity of OSATS

Resident Level	n	Global (OSATS-G)	Checklist (OSATS-C)
PGY-1	7	5.05	7.56
PGY-2	6	15.43	16
PGY-3	5	18.75	19.63
PGY-4	8	19.31	15.88
		p = .001	p = .041

Kruskal-Wallis Test

Table 4. Construct validity

	n	Global (OSATS-G)	Checklist (OSATS-C)
Junior Residents (R1 & R2)	13	21.33	28
Senior Residents (R3 & R4)	13	27.67	35.5
		p = 0.004	p = 0.046

Kruskal-Wallis Test

Table 5. Reliability Indices

	Inter-rater reliability	Test-retest reliability	Internal consistency*
checklist (OSATS-C)	0.93	0.9	0.82
global (OSATS-G)	0.96	0.89	0.93

* Crohnbach's alpha

Table 6. Comparison of intervention and control groups

	Intervention group (n= 14)	Control group (n=12)	p value
Mean Age*	30	32	
Gender†			
Male	5	3	0.61
Female	9	9	1
Resident level‡			
PGY-1	5	2	0.39
PGY-2	3	3	1
PGY-3	2	3	0.64
PGY-3	4	4	1
Baseline assessment (OSATS composite score)‡	22	22.17	0.77

* Student's t Test

† Fisher's Exact Test

‡ Kruskal-Wallis Test

Table 7. Effectiveness of Educational Intervention

	Intervention group (n= 14)	Control Group (n= 12)	p-value
global (OSATS-G)	28	32	< 0.001
checklist (OSATS-C)	26	37	< 0.001
written examination	15	27	0.007
composite score	21.67	28.67	0.001

Table 8. Effectiveness of Educational Intervention by resident level

	Intervention Group (n=14)	Control Group (n=12)	p value
PGY-1			
OSATS-G	23	18	0.241
OSATS-C	30.5	21	0.079
written examination	22	13.55	0.165
Composite score	22.67	16.33	0.165
PGY-2			
OSATS-G	31	29	0.248
OSATS-C	37	30	0.148
written examination	27	19	0.046
Composite score	27	23	0.068
Junior (PGY-1 + PGY-2)			

OSATS-G	29	21.5	0.091
OSATS-C	33	25.5	0.01
written examination	27	16	0.046
Composite score	26.33	20.33	0.089
PGY-3			
OSATS-G	32	29	0.021
OSATS-C	38	27	0.059
written examination*	27		
Composite score*	27.67		
PGY-4			
OSATS-G	33.5	29.5	0.486
OSATS-C	37	27.5	0.029
written examination	26.5	15	0.029
Composite score	30.17	23.17	0.029
Senior (PGY-3 + PGY-4)			
OSATS-G	32	28	0.041
OSATS-C	37	26	0.004
written examination	27	15	0.008
Composite score	28.67	21.67	0.014

* no data available for PGY-3 + control group

data analyzed by Kruskal-Wallis Test

Table 9. Spearman Correlation between assessment tools

	before intervention	after intervention
OSATS-C vs. written examination	0.15 (p = 0.48)	0.82 (p < .001)
OSATS-C vs. OSATS-G	0.67 (p < .001)	0.82 (p < .001)
OSATS-G vs. written examination	0.48 (p = .015)	0.58 (p=.003)

Figure 1. 4th Degree Perineal Laceration Anatomic Replica

Figure 2. Layers of the 4th degree laceration

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Effects of an Educational Workshop on Performance of Fourth-Degree Perineal Laceration Repair

Sam Siddighi, MD, Steven D. Kleeman, MD, Michael S. Baggish, Christopher M. Rooney, MD, Rachel N. Pauls, MD, and Mickey M. Karram, MD

OBJECTIVE: To develop a valid and reliable tool to objectively measure surgical skill necessary for repair of fourth-degree perineal lacerations and then to use this tool to measure improvement after a workshop.

METHODS: We measured baseline surgical ability and clinical knowledge of 26 residents (postgraduate year [PGY]-1 to PGY-4) using the Objective Structured Assessment of Technical Skills (OSATS) and a written examination. The OSATS consists of a global surgical skills assessment (OSATS-G), a procedure checklist (OSAT-C), and pass/fail grade. Five weeks after our baseline evaluation, a 1.5-hour workshop was administered to approximately half of the 26 residents (n=14). One week after this intervention, the residents were re-examined using the same assessment tools.

RESULTS: The OSATS demonstrated construct validity as scores on the examination increased on both the OSATS-G and the OSATS-C from PGY-1 through PGY-4 ($P=.001$ and $P=.041$, respectively). Reliability indices for the OSATS were high. Eighty-one percent of the residents failed the OSATS before intervention because of failure to identify and repair the internal anal sphincter. After educational intervention, senior residents improved on all assessments (OSATS-G, $P=.041$; OSATS-C, $P=.004$; written examination, $P=.008$), and all residents passed the OSATS.

CONCLUSION: A valid and reliable OSATS and written examination were developed to assess surgical skills, knowledge, and judgment necessary to properly manage fourth-degree perineal lacerations. Residents improved

on the OSATS and the written examination after undergoing a structured educational workshop.

(*Obstet Gynecol* 2007;109:289–94)

LEVEL OF EVIDENCE: II

Up to 50% of women experience some degree of fecal incontinence after anal sphincter repair.^{1–4} Three fourths of women who have been repaired after a third- or fourth-degree tear have persistent defect in the anal sphincter musculature 15 months after a repair.⁵ Sphincter injuries that are recognized at the time of delivery are repaired most times by a junior resident physician who is unfamiliar with the anatomy.⁶ Furthermore, with the decline in forceps deliveries and reduction of resident work hours, all graduating obstetrics and gynecology residents are acquiring less experience in the repair of these advanced perineal lacerations.⁷ Training and testing on commercial anatomic replicas may be helpful in enhancing the acquisition of technical skills for repair of these advanced perineal lacerations.

In-training (eg, Council on Resident Education in Obstetrics and Gynecology) as well as written and oral board examinations assess cognitive knowledge and clinical judgment. Technical proficiency, however, is not easily evaluated. Case logs and faculty evaluations are imprecise and unreliable methods of evaluating physician competence. Unfortunately, most resident training programs rely on these subjective faculty assessments.^{8,9}

The Objective Structured Assessment of Technical Skills (OSATS) is a valid and reliable method of measuring surgical skills, and it has been validated for different types of procedures in both general surgery and obstetrics and gynecology.^{10–15} Early in its development, it was demonstrated that OSATS measures using bench models is equivalent to those using live animals.¹¹ Advantages of inanimate anatomic models

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include availability, lower cost, and portability, and use of the models obviates the ethical issues involved in the use of live animals.

The purpose of this study was to develop a valid and reliable OSATS to measure surgical skill necessary for proper repair of fourth-degree perineal laceration. We hypothesize that technical skills, knowledge, and judgment pertinent to these repairs will improve after a structured educational workshop.

MATERIALS AND METHODS

The OSATS consists of a global surgical skills assessment (OSATS-G), a procedure checklist (OSATS-C), and a pass/fail grade. Table 1 describes OSATS in detail. We used the original global assessment evaluation form developed by Reznick⁹ to assess general surgery residents performing inguinal hernia repairs. We developed our own procedure checklist for fourth-degree perineal laceration repair following the recommendations in *Williams Obstetrics*, 22nd edition.¹⁶ Finally, we gave a pass or fail grade based on criteria described in Table 1.

The residents arrived in the testing room, which contained the fourth-degree laceration anatomic replica, an adjustable light, and appropriate and multiple distracter sutures and instruments. The same clinical scenario was read to all of the residents, and then standardized instructions were given. The examiners acted as surgical assistants, did whatever was asked of them, but did not give input or assistance unless they were asked. The extent of the obstetric laceration was

not stated. Four evaluators completed the OSATS score sheets for each resident.

Twenty-six obstetrics and gynecology residents from TriHealth Hospitals in Cincinnati, Ohio, participated in baseline assessment and reassessment using OSATS. Testing and retesting were separated by 6 weeks because each session lasted more than 6 hours (7 am to 1:30 pm) and interfered with clinical duties. Therefore, the chairman of the department permitted testing only during the monthly resident education day set aside for the Division of Urogynecology and Reconstructive Pelvic Surgery. In this study, we were interested in studying the short-term effects of a workshop. Thus, our educational intervention was scheduled exactly 1 week before the retesting date. Residents were re-examined with the same assessment tools. The intervention group, which consisted of about half (n=14) of the residents from each level of training, underwent a 1.5-hour workshop (Table 2). Residents at Trihealth residency program are evenly split between two hospitals that are geographically separated. To minimize interaction between the intervention and control groups, those residents doing their rotation at Good Samaritan Hospital during our study period were assigned to the intervention group.

Residents repaired fourth-degree laceration on a commercial anatomic replica, the Sultan Anal Sphincter (Limbs and Things Inc, Bristol, UK) (Fig. 1). This model comes with a replaceable perineal pad that allows approximately 24 repairs before replacement is necessary. Each model (skin, 1 perineal pad, base,

Table 1. Objective Structured Assessment of Technical Skills (OSATS) for Fourth-Degree Perineal Laceration Repair

	Criteria for Evaluation	Example
Global assessment (OSATS-G)	<ol style="list-style-type: none"> 1. Knowledge of procedure 2. Flow of operation 3. Respect for tissue 4. Time and motion 5. Knowledge of instruments 6. Instrument handling 7. Use of assistants 	5 points on "flow of operation" means "obviously planned course of operation with effortless flow from one move to the next."
Procedure checklist (OSATS-C)	<ol style="list-style-type: none"> 1. Extent of injury 2. Anesthesia consideration 3. Choice of suture and instrument 4. Re-approximation of anatomic landmarks <ol style="list-style-type: none"> a) Rectal mucosa b) Internal anal sphincter c) External anal sphincter 5. Re-evaluation of scenario 	5 "✓" marks on external anal sphincter equals: <ul style="list-style-type: none"> ● 4–6 sutures placed using ● 2.0 or 3.0 Vicryl ● to re-approximate muscle and capsule; ● sutures placed in the following order: posterior (3 o'clock), inferior (6 o'clock), superior (12 o'clock), anterior (9 o'clock) and held; ● posterior and inferior sutures tied first
Pass/fail grade	<ol style="list-style-type: none"> 1. Less than 10 points on OSATS-G and/or 2. Failure to identify or repair 1 of 3 anatomic landmarks and/or 3. Not completing entire repair in 25 minutes 	Not identifying and repairing the internal anal sphincter during repair means the resident received a "fail" grade on the OSATS

Table 2. Structured Workshop for Fourth-Degree Perineal Laceration Repair

	Nature of Intervention	Time (min)	No. of Slides
Powerpoint didactic using color illustrations, animation, reiteration of main points of each slide, and verbal quizzing at end of each slide (approximately 2 minutes per slide)	Review pelvic and perineal anatomy	10	5
	Embryology of pelvic organs and perineum	4	3
	Epidemiology	2	1
	Review suture types and knot-tying	4	2
	Review needle shapes/points and needle control	4	2
	Review instrument names and proper handling	4	2
	Review surgical concepts (eg, bleeding, anesthesia)	4	3
	Review definitions of third- and fourth-degree laceration	2	2
	Review proper repair of fourth-degree laceration	20	7
	Complications of fourth-degree repair	4	2
	Review risk factors and prevention strategies	2	1
		60	30
Practice session	Fourth-degree anatomic replica and appropriate instruments and sutures were provided; residents practiced repair while being coached	30

Fig. 1. Commercial anatomic replica (Sultan Anal Sphincter Trainer; Limbs and Things Inc, Bristol, UK). Replaceable perineal pad (arrow). Note the vaginal lumen (A) and submucosa (B).

Siddighi. Fourth-Degree Laceration Workshop. *Obstet Gynecol* 2007.

and clamps) costs approximately \$642.94. Each additional replacement perineal pad costs \$109.22.

This study was reviewed and approved by the Good Samaritan Hospital Institutional Review Board and funded by the Hatton Institute for Research and Education. The four evaluators underwent a 30-minute examiner orientation before the study was begun. They also participated in a pilot study to demonstrate high interrater reliability on the OSATS-C and OSATS-G.

Statistical analyses were performed with SPSS 14.0 for Windows (SPSS Inc, Chicago, IL). The consistency of our tests was measured by test-retest, interrater, and internal consistency reliability (Cron-

bach α) indices. Construct validity is a proxy for validity or the extent to which a test measures what it is intended to measure. Because of ordinal measures and small group-specific sample sizes, Kruskal-Wallis and Dunn tests were used to establish construct validity. Fischer exact and t tests were used to establish similarity between the control group and the intervention group. Spearman ρ correlation coefficients were used to measure correlation between OSATS-G, OSATS-C, and written examination scores. $P < .05$ was considered statistically significant.

RESULTS

Table 3 demonstrates a rising trend in the scores from postgraduate year (PGY)-1 to PGY-4. In Table 4, construct validity is established as senior residents perform better than junior residents on the OSATS. Our assessment techniques were highly reliable (Table 5). The written examination did not demonstrate construct validity ($P = .052$), but its test-retest reliability was high (0.91). Eighty-one percent of all residents (35% of senior residents) failed the baseline assessment because they failed to recognize and repair the internal anal sphincter.

Table 3. Construct Validity of Objective Structured Assessment of Technical Skills (OSATS)

Resident Level	n	Global (OSATS-G)	Checklist (OSATS-C)
PGY-1	7	5.05	7.56
PGY-2	6	15.43	16
PGY-3	5	18.75	19.63
PGY-4	8	19.31	15.88
Kruskal-Wallis test		$P = .001$	$P = .041$

OSATS, Objective Structured Assessment of Technical Skills; OSATS-G, OSATS-Global; OSATS-C, OSATS-Checklist; PGY, postgraduate year.

Table 4. Construct Validity

	n	Global (OSATS-G)	Checklist (OSATS-C)
Junior residents (PGY-1 and PGY-2)	13	21.33	28
Senior residents (PGY-3 and PGY-4)	13	27.67	35.5
Kruskal-Wallis test		$P=.004$	$P=.046$

OSATS, Objective Structured Assessment of Technical Skills;
OSATS-G, OSATS-Global; OSATS-C, OSATS-Checklist.

Table 5. Reliability Indices

	Interrater Reliability	Test-Retest Reliability	Internal Consistency*
Checklist (OSATS-C)	0.93	0.9	0.82
Global (OSATS-G)	0.96	0.89	0.93

OSATS, Objective Structured Assessment of Technical Skills;
OSATS-G, OSATS-Global; OSATS-C, OSATS-Checklist.

* Cronbach α .

The control group and the intervention group did not differ in demographic characteristics. Both groups also had similar baseline composite scores on the OSATS (Table 6). The intervention group performed better than the control group on the OSATS-G, OSATS-C, and written examination (Table 7). Additionally, the PGY-2, PGY-3, PGY-4 residents improved in at least one of the assessments. The senior residents improved on all assessments after the intervention (Table 8). All residents passed the OSATS after intervention.

Table 9 shows the Spearman ρ correlation between

Table 6. Comparison of Intervention and Control Groups

	Intervention Group (n=14)	Control Group (n=12)	P
Mean age (y)*	30	32	.21
Gender†			
Male	5	3	.61
Female	9	9	1
Resident level†			
PGY-1	5	2	.39
PGY-2	3	3	1
PGY-3	2	3	.64
PGY-4	4	4	1
Baseline assessment (OSATS composite score)*	22	22.17	.77

PGY, postgraduate year; OSATS, Objective Structured Assessment of Technical Skills.

* Student t test.

† Fisher exact test.

‡ Kruskal-Wallis test.

Table 7. Effectiveness of Educational Intervention

	Intervention Group (n=14)	Control Group (n=12)	P
Global (OSATS-G)	32	28	<.001
Checklist (OSATS-C)	37	26	<.001
Written examination	27	15	.007
Composite score	28.67	21.67	.001

OSATS, Objective Structured Assessment of Technical Skills;
OSATS-G, OSATS-Global; OSATS-C, OSATS-Checklist.

Table 8. Effectiveness of Educational Intervention by Resident Level

	Intervention Group (n=14)	Control Group (n=12)	P
PGY-1			
OSATS-G	23	18	.241
OSATS-C	30.5	21	.079
Written examination	22	13.55	.165
Composite score	22.67	16.33	.165
PGY-2			
OSATS-G	31	29	.248
OSATS-C	37	30	.148
Written examination	27	19	.046
Composite score	27	23	.068
Junior (PGY-1 + PGY-2)			
OSATS-G	29	21.5	.091
OSATS-C	33	25.5	.01
Written examination	27	16	.046
Composite score	26.33	20.33	.089
PGY-3			
OSATS-G	32	29	.021
OSATS-C	38	27	.059
Written examination*	27		
Composite score*	27.67		
PGY-4			
OSATS-G	33.5	29.5	.486
OSATS-C	37	27.5	.029
Written examination	26.5	15	.029
Composite score	30.17	23.17	.029
Senior (PGY-3 + PGY-4)			
OSATS-G	32	28	.041
OSATS-C	37	26	.004
Written examination	27	15	.008
Composite score	28.67	21.67	.014

PGY, postgraduate year; OSATS, Objective Structured Assessment of Technical Skills; OSATS-G, OSATS-Global; OSATS-C, OSATS-Checklist.

Data were analyzed by Kruskal-Wallis test.

* No data available (did not take written examination).

the different assessment techniques. There was moderate correlation between OSATS-G and OSATS-C before intervention. After intervention, both OSATS-C versus with OSATS-G and OSATS-C versus with written examination were strongly correlated.

Table 9. Spearman Correlation Between Assessment Tools

	Before Intervention	After Intervention
OSATS-C versus written examination	0.15 ($P=.48$)	0.82 ($P<.001$)
OSATS-C versus OSATS-G	0.67 ($P<.001$)	0.82 ($P<.001$)
OSATS-G versus written examination	0.48 ($P=.015$)	0.58 ($P=.003$)

OSATS, Objective Structured Assessment of Technical Skills; OSATS-G, OSATS-Global; OSATS-C, OSATS-Checklist.

DISCUSSION

The OSATS is a valid and highly reliable assessment tool and has been used successfully with several types of surgical procedures to measure resident physician operating skill proficiency. The OSATS assessment using commercial anatomic replicas allows residency programs and board examiners to test technical skill. It also offers the advantages of availability, portability, and cost-savings over live animals and cadavers. In our study, we demonstrated that our OSATS for fourth-degree laceration repairs is both valid and highly reliable. A statistically significant rising trend in scores on both the checklist and the global assessment tools was observed as one progressed from junior to more senior level residents.

Correlations between the OSATS-G and OSATS-C and between the OSATS-C and written examination were high after our workshop. This suggests that a written examination by itself, which is easier to administer and less time-consuming, may suffice as a technical assessment tool if administered after a highly structured workshop.

Approximately 81% of all residents, including 35% of senior residents, failed the OSATS because they did not recognize the existence of internal anal sphincter and made no attempt to repair it. We doubt that this occurred because of the inadequacies of our commercial anatomic replica because the internal anal sphincter layer is obvious and prominent (Fig. 2). To highlight the gravity of this issue, our residents are above the national average for the number of vaginal deliveries, instrument deliveries, and third- and fourth-degree laceration repairs. In 2005, one of the two TriHealth Hospitals had 4,401 vaginal deliveries, and 11% of these were forceps deliveries while 6% were vacuum deliveries. Residents at this hospital were exposed to 461 third-degree and 159 fourth-degree lacerations. Since the internal anal sphincter makes up 70–80% of the resting tone of the anal sphincter, it is very important to recognize and fix this

Fig. 2. Fourth-degree laceration commercial anatomic replica showing the three layers. Note the external anal sphincter (arrow), the internal anal sphincter (A), and the rectal mucosa (B).

Siddighi. Fourth-Degree Laceration Workshop. *Obstet Gynecol* 2007.

structure properly. Thus, a nationwide educational effort is needed to address this problem.

The limitations of this study are as follows. First, because of the need to minimize interaction between the two groups, the intervention was not assigned by an accepted randomized method such as computer generation or random digit table. However, we doubt that this was a source of bias since residents are not assigned to their rotations in any systematic fashion. Additionally, baseline OSATS scores for the two groups were highly comparable. Another limitation is that sample size was small and residents were trained and tested by familiar faculty.

We did not study the diminution of testing effects with time or the long-term effects of our intervention. We also did not study the effects of varying our educational intervention. For example, one may study the effects of different types of intervention (didactic versus video versus self-practice).

In conclusion, we developed a valid assessment tool that was able to reliably quantify surgical skill. We were able to objectively measure improvement in surgical ability after an educational intervention.

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