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ORIGINAL ARTICLE

Use of a beef tongue model and instructional video for teaching residents fourth-degree laceration repair

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Abstract
Introduction and hypothesis This study seeks to compare the utility of the beef tongue model versus an instructional video in teaching obstetric and gynecology residents how to repair a fourth-degree laceration.
Methods Twenty-seven residents were randomized to participate in a workshop with a beef tongue model or assigned to watch an instructional video on repair of fourth-degree lacerations and read a chapter on the repair. All subjects were tested with a pre- and postintervention written test. These scores were compared with paired *t* test at 0.05 significance level.
Results Residents with no prior experience in fourth-degree laceration repairs showed an improvement in knowledge (49.5% versus 64.1%, $p<0.001$) on written exams about the repairs.
Conclusions An instructional video or beef tongue model and textbook chapter on fourth-degree laceration repair can improve skills in repair of a fourth-degree laceration among residents with no experience in these repairs.

Keywords Beef tongue model · Fourth-degree laceration · Simulation training

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Introduction

As rates of forceps, episiotomy, and vaginal deliveries decline, experience in repair of third- and fourth-degree lacerations is declining in residency programs [1]. In a national survey of program directors of obstetrics and gynecology residency training programs, 6.8% of 297 residents had repaired more than 20 fourth-degree lacerations [1]. Even if the need for repair of fourth-degree lacerations is diminishing, residents still should be proficient in this type of advanced repair.

A model for teaching complicated surgical technique and/or anatomy allows for learning surgical skills without the pressure and risk of working on live patients. The beef tongue model has been used for teaching wound closure techniques to students [2]. Sauerwein and colleagues modified the model to teach episiotomy repairs [3]. The model functions as a realistic simulation to demonstrate the anatomy of a fourth-degree laceration by using a beef tongue, tubing, and colored string. Compared with plastic anatomic models, the beef tongue model replicates the feel of tissue and better allows for residents to learn how to suture and handle tissue.

Anatomical models and hands-on workshops to teach residents how to repair fourth-degree lacerations can improve their knowledge and technique [4]. However, the use of workshops and anatomical models requires time and expense. Instructional videos are meant to serve the same purpose as workshops and models but do not require same amount of time, manpower, and expense. They can be distributed so that residents can learn independently.

Although there are strengths and weaknesses to each of these two methods for teaching/training, it has not been demonstrated whether using one confers an advantage over the other with respect to written and practical proficiency.

The aim of this study was to evaluate if residents who are taught fourth-degree laceration anatomy and repair on the beef tongue model would have better scores on a written examination about fourth-degree laceration anatomy and repair compared with residents who received a standard instructional video.

Materials and methods

Institutional Review Board approval was obtained prior to initiation of the study. Obstetrics and gynecology residents at University of Connecticut Health Center were eligible for participation. Of 36 eligible residents, 27 agreed to participate (75%) and signed an informed consent form.

Participating residents were randomly divided into two groups. Randomization was performed using a computer-generated block design so that each group had a balanced distribution of residents in each postgraduate year training (PGY) level. Both groups were given a chapter from the *Williams Obstetrics* text book on episiotomy repair, which included information on repair of fourth-degree lacerations [5]. The reading material was provided after the subjects took the preintervention written test and was meant to serve as a supplement to the interventions. One group, video intervention ("VI"), watched an instructional video on fourth-degree laceration repair that is provided by the American College of Obstetricians and Gynecologists. The other group, beef tongue ("BT"), participated in a hands-on instructional workshop using the beef tongue model to learn fourth-degree laceration anatomy and repair technique.

The beef tongues were prepared according the Sauerwein et al. manual [3] to simulate a perineum by placing a piece of Mallencot tubing covered with a small piece of a penrose drain through a cross section of the tongue to mimic the internal and external anal sphincter. The wide end of a red rubber catheter was placed longitudinally through the section of beef tongue to simulate the rectum. A cut was made through the tongue to expose cut edges of the tubing and catheter to simulate a fourth-degree laceration (Fig. 1).

All participants took a written, 12-question short-answer test (Appendix 1) before any intervention to assess baseline knowledge about anatomy and repair of fourth-degree lacerations. The questions were formulated based on the key points about fourth-degree laceration repair in the Williams chapter and consensus among the authors. After taking the written test, they received the Williams' obstetrics chapter to read about fourth-degree laceration repair. The residents who were assigned to the BT group participated in a 60-min, hands-on session with the faculty from the division of urogynecology at Hartford Hospital. At this instructional session, each subject was provided with a prepared beef tongue. All instructors for the workshop used the same sutures, instruments, and technique for performance of the repair. All subjects were closely supervised during the instructional workshop to ensure that they understood the anatomic landmarks to identify and how to perform the entire repair. The subjects in the VI group watched the instructional video. This group was exposed to the same sutures, instruments, and technique as the BT group, except that they did not actually perform the repair on models. Both groups received the same instructions from the supervising faculty.

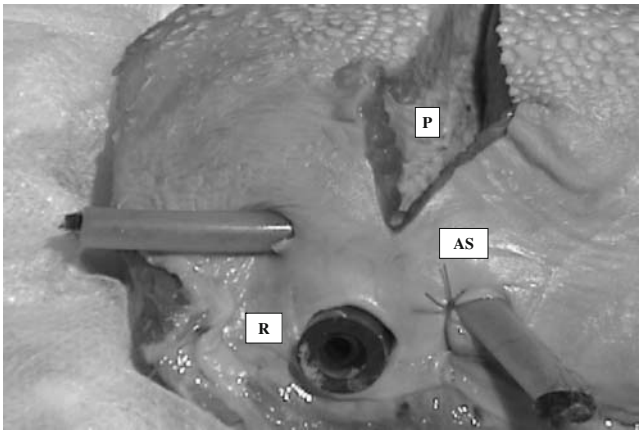

Fig. 1 Picture of beef tongue model as described by Sauerwein et al. [3]. By cutting through the perineum into the tubing for the anal sphincter and the rectum, one creates the fourth degree laceration. (Reference: Teaching advanced episiotomy repair with a beef tongue model. Beef Tongue Episiotomy Workshop Manual. *Central Washington Family Medicine*, Yakima, Washington). *P* perineum, *AS* anal sphincter, *R* rectum

Approximately 4 weeks later, the subjects were tested on their knowledge of the fourth-degree laceration repair and took the written test again. The flow of subjects in the trial is shown in Fig. 2. Subjects could not be blinded to the assigned group due to the nature of the interventions. The examiners could not be blinded to the assignments since they had provided the BT instructional workshop.

Before performing the postintervention exams, three mock scoring sessions were held in order to standardize the scoring to the practical exams. The practical exam was scored using a procedure checklist (Appendix 2) that broke down the performance of the repair by extent of injury, anesthesia, suture materials used, and technique of the repair.

Power and sample size

An a priori power analysis suggested that a sample size of 16 in each group would afford 83% power to detect differences in the 12-question written exam of 4.0 (10.0 in

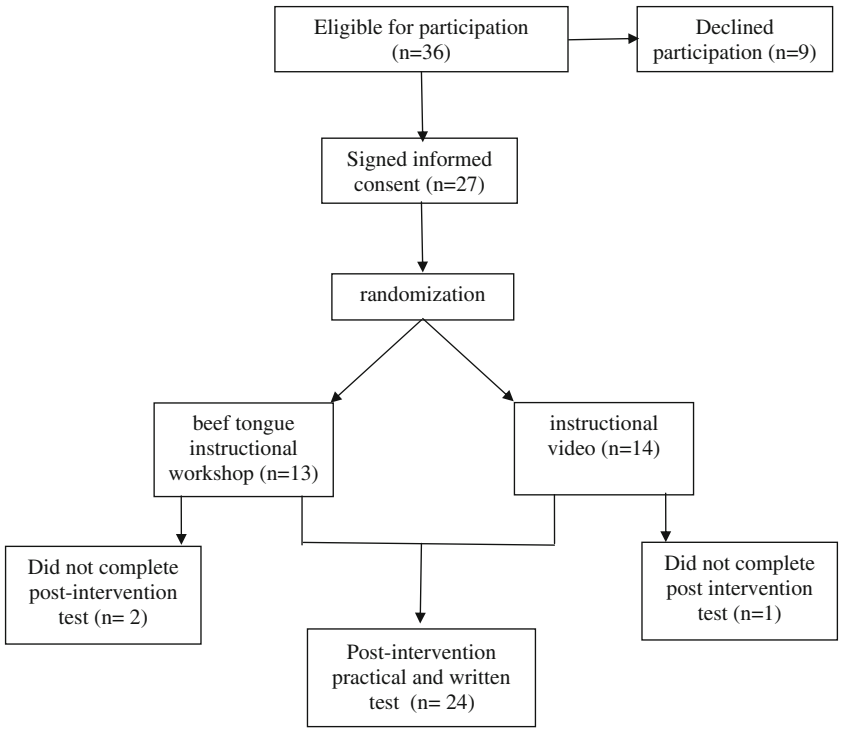

Fig. 2 Flow of subjects through the study

the video group and 14.0 in the beef tongue model group), with a common standard deviation of 3.75.

Statistical analysis

The means of the test scores were compared between video and beef tongue model groups with a paired *t* test. The primary hypothesis to compare postintervention test scores on both the procedure and the written test between groups was tested with one-way analysis of variance (ANOVA). The postintervention procedure and written test scores also were compared between PGY levels and based on the number of fourth-degree lacerations with which the subjects had experience repairing. Any significant differences with analysis of variance were compared using a *post hoc* Scheffé's test. All tests were performed at the 0.05 significance level with SPSS v. 14.0 (SPSS Inc., Chicago, IL 2006) and JMP 6.0 (SAS, Cary, NC, USA).

Results

Twenty-seven of the eligible residents (75%) completed the baseline written examination. The distribution of subjects is shown in Fig. 2; baseline information is listed in Table 1. The residents who did not participate were mostly in the PGY 4 level due to fellowship interviews at the time of the study. The mean pretest written score for all subjects was 52.7% (±23.0%). There were three subjects who did not complete the postintervention tests, two in the instructional workshop, and one in the instructional video group. These subjects were on vacation or on call and could not attend the postintervention sessions.

Scoring of the procedure checklist was tested for agreement between examiners using mock scoring session on a total of nine cases over three sessions. Interexaminer agreement was 69% for the procedure checklist. All of the subjects were scored on how they performed a fourth-degree laceration using the beef tongue model based on the postintervention procedure checklist.

The postintervention written test scores for the PGY 1 subjects showed an improvement from baseline ($p<0.001$, ANOVA), but other groups' scores were not significantly different from the preintervention written test scores. When the subjects were stratified by the number of fourth-degree lacerations reported, either zero or at least one repair, there was a significant improvement in written exam scores for the group with no experience in repair of fourth-degree lacerations (49.5% versus 64.1%, $p<0.001$, ANOVA). The VI and BT groups were not significantly different when comparing the preintervention and postintervention written test scores and the procedure checklist scores (Table 2).

Discussion

Results from this study demonstrate that use of either a beef tongue or an instructional video can provide good knowledge

Table 1 Group assignments and fourth-degree laceration repair experience

PGY level	Instructional video (*n* participants)	Instructional workshop (*n* participants)	Experience with fourth-degree repairs (range)	pretest scores,% [mean, (SD)]*
1	4	3	0	27.1 (13.8)[a]
2	4	6	0–1	52.2 (12.6)
3	2	3	2–3	61.8 (23.8)
4	2	3	1–2	84.9 (10.6)

*$p<0.0001$, ANOVA, when compared to scores for PGY-4

[a] Maximum number of points=17

and training of the anatomy and repair of a fourth-degree laceration to obstetric and gynecology residents with no prior experience in repair of these lacerations.

This study showed that there was limited experience with fourth-degree laceration repairs among the PGY levels. Among those with no prior experience in repairing fourth-degree lacerations, both interventions improved knowledge of anatomy and procedure of the repair. There was above-average knowledge about repair of fourth-degree lacerations among the PGY 3 and PGY 4 levels.

The use of simulation models to teach surgical skills provides a valuable tool to assist during residency. The use of these simulation models has been demonstrated to improve laparoscopy and episiotomy repair skills [4, 6, 7]. Even a sponge simulation of a perineum has been shown to improve episiotomy repair skills [8].

The types of models used for simulation-based training can range from plastic (low fidelity bench simulators or video box trainers) to live tissue (high fidelity virtual reality simulators or animal models) [9]. The more realistic models are more expensive to acquire; so, for large-scale training, such as with residency training, use of less expensive simulations is often more feasible. Skills learned in simulation training do not always completely transfer to the actual procedures [10]. A review of studies comparing simulation models to standard training found that while no simulation model is superior to surgical training, models are better than no training [11]. Thus, while they are valuable for use in surgical training, these models should be used to enhance standard training and cannot replace real experience.

The study was limited by the small sample size. The small numbers may have limited our ability to detect a difference in improvement between the two interventions. For ethical reasons, we were not able to make this study a mandatory part of residency training, so we did not meet out enrollment goal. In addition, it would have been beneficial to test the subjects on performing the repair before the intervention. This would have allowed for comparison of procedure scores between the groups. However, it was not feasible to perform preintervention procedure tests on all the residents as they were at three different hospital training sites.

The written exam was not rigorously tested for validity and reliability. However, it consisted of recall questions that were specific to fourth-degree laceration repair and so likely did allow for demonstrating adequate knowledge on the specific procedure.

Scoring on the procedure was limited by the interexaminer agreement of 69%, which was moderate but not above our goal of 80%. We attempted to decrease the variability in scoring by using very detailed checklists that required "yes/no" answers and reviewing the scoring on several occasions with all the examiners.

There were also a limited number of opportunities to test the residents, which made it difficult to capture all who were eligible to participate. To minimize the effect of recall on the subjects in the BT group, we performed the postintervention testing 4 weeks after the interventions. There still may have been some recall of this model, but there was no difference in procedure-specific checklist scores between the two groups, so there was likely a minimal impact. The examiners were not blinded to group assignment due to the logistics of completing the study. This could have introduced bias in the scoring of the procedures. However, there were 4 weeks between the intervention and the testing, so it is unlikely that all examiners remembered the group assignments. In addition, the procedure was scored with a series of steps that the subject either performed or did not, so this minimized the subjective scoring of the procedure.

Even though both the instructional video and beef tongue model showed improvements in written knowledge of fourth-degree lacerations in those with no experience in these repairs, the use of the model for teaching the procedure has the advantage of allowing

Table 2 Comparison of scores based on intervention

Group	Preintervention written test [%, (SD)]	Postintervention written test [%, (SD)]	Postintervention procedure checklist score[a] [number, (SD)]
Instructional video	46.4% (26.1)[b]	62.4% (17.4)[b]	6.0 (1.3)[b]
Instructional workshop	57.3% (20.8)	72.5% (4.8)	6.6 (1.9)

[a] Maximum number of points=9

[b] Nonsignificant difference between groups

the residents to perform the procedure rather than watching the procedure. In addition, the significant improvement in knowledge for the PGY 1 year indicates that they may receive the most benefit from this type of educational intervention early in training. By providing this training early on in residency, they may understand and perform these complex repairs better than if they learned by watching or assisting with a repair on an actual patient.

Based on this study, both an instructional video and beef tongue model along with the Williams' obstetrics chapter on fourth-degree laceration repair provide improvement in knowledge of fourth-degree laceration repair among obstetrics and gynecology residents with little or no experience in fourth-degree laceration repairs. The next step will be to develop procedure guidelines to test performance of the residents in clinical settings to see if the knowledge they acquire during the educational sessions, either watching the instructional video or learning on the beef tongue, improves their ability to do the repair on actual patients.

Conflicts of interest None.

Appendix 1

Written test for knowledge on fourth-degree laceration repair

Table 3 Written test for knowledge on fourth-degree laceration repair

Question	Answer(s)	Point (pt.) value (max=17)
1. How is a third-degree laceration identified?	A tear that goes through the anal sphincter	1 pt.
2. How is a fourth-degree laceration identified?	A tear that goes through the rectal mucosa to expose the lumen of the rectum	1 pt.
3. What are the three anatomic landmarks to identify before repairing a fourth-degree laceration?	1) The torn edges of rectal mucosa 2) Cut ends of the internal anal sphincter 3) Ends of external anal sphincter	1 pt. each (max=3)
4. True or false: Episiotomy is not associated with an increased risk for third- and fourth-degree lacerations.	False	1 pt.
5. Which sutures should be used for the repair of a fourth-degree laceration?	For rectal mucosa: 4-0 vicryl suture; for the external anal sphincter: 2-0 or 3-0 vicryl suture	0.5 pt. each (max=1)
6. How many sutures (if any) should be placed to reapproximate the ends of the external anal sphincter?	Use 4-6 interrupted sutures	1 pt.
7. Describe the locations of the sutures (if any) to be placed in the ends of the external anal sphincter.	Posterior, inferior, anterior, and superior or 3, 6, 9, and 12 o'clock	0.25 pts. each (max=1)
8. What instruments are necessary for the repair of a fourth-degree laceration?	Needle drivers, Allis clamps, tissue forceps, scissors	0.25 pts. each (max=1)
9. What are the two different techniques for repair of the external anal sphincter?	Overlapping and end to end	0.5 pt. each (max=1)
10. What is the main long-term consequence of fourth-degree lacerations?	Risk for future fecal incontinence	1 pt.
11. What are the necessary things to set up before starting a repair of a fourth-degree laceration?	Lighting, retractors, assistants, sutures	1 pt. each (max=4)
12. What types of anesthesia can be used for a fourth-degree laceration?	Regional, general, local, or pudendal block	1 pt. each (max=4)

Appendix 2

Procedure checklist used to score all subjects on performance of fourth-degree laceration on beef tongue model after interventions

Scoring of the fourth-degree laceration repair on beef tongue

Examiner name:_____

Subject:_____

Procedure checklist	Yes	No	Points
1. Identifies extent of injury			1
2. Anesthesia consideration			1/2
3. Lighting consideration			1/2
4. Reapproximated rectal mucosa			1
5. Uses 4.0 vicryl on rectal mucosa			1/2
6. Reapproximated rectal mucosa in either running fashion OR interrupted fashion *(OK if person puts a second running (not locked) imbricating layer in, but not part of scoring)*			1/2
7. Reapproximated internal anal sphincter			1
8. Use 2.0 or 3.0 vicryl or 2.0 PDS on External/internal anal sphincter			1/2
9. Uses Allis clamps to mark torn ends of anal sphincter			1/2
External Anal Sphincter Technique			
10a1. Used End to end Reapproximation on external anal Sphincter			1
10a2. For end to end Reapproximation put together in following order: posterior→ inferior→superior→anterior			1
OR			
10b1. Used Overlapping technique to reapproximate external anal sphincter AND placed sutures as vertical mattresses			1
10b2. Dissected out external anal sphincter before placing sutures			1
11. Tying sutures in *same order* after all placed			1/2
12. Performed 2nd degree repair			1/2

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