FIBEROPTIC ENDOSCOPIC EXAMINATION OF SWALLOWING (FEES) TRAINING

GRADUATE STUDENTS USING HUMAN AND NONHUMAN SIMULATION

By

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GRADUATE STUDENTS USING HUMAN AND NONHUMAN SIMULATION

Abstract

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Purpose: A challenge facing the field of speech-language pathology is how to adequately train students at the university level to acquire the endoscopy skills needed to perform FEES. The use of simulation has the potential to allow speech-language pathology students, desiring endoscopy training, to gain experience with repetitive practice without compromising patients. The purpose of this study was to compare the effects of multiple transnasal endoscopic passes on standard patients and the effects of two different forms of training, human simulation and nonhuman simulation, as measured by reduction in the time needed to pass a fiberoptic nasolaryngoscope.

Method: Eighteen speech-language pathology second year graduate student clinicians were randomly assigned to either a human simulation training group or a nonhuman simulation training group. Each training group attended a 90 minute training session on Day 1. On Day 2, each clinician passed the fiberoptic nasolaryngoscope on two different standard patients. Each standard patient was scoped two times, once by a clinician trained using human simulation and once by a clinician trained using nonhuman simulation.

Results: There was no difference in pass times for clinicians trained using human simulation using a manikin and nonhuman simulation. Level of clinician confidence was related to Total Procedural Time and total Time in the Nose on Scope 2. The importance of practice and

repetition was evidenced in faster transnasal endoscopic pass times and increased confidence

ratings between Scope 1 and Scope 2.

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CHAPTER 1

INTRODUCTION

Fiberoptic endoscopic evaluation of swallowing procedure (FEES) is utilized to examine the anatomy of pharyngeal structures from the level of the soft palate or below, as well as examine the pharynx and larynx before and after swallowing [1]. This diagnostic procedure is beneficial due to the ability to see fatigue over the course of a meal without radiation exposure [2]. In the FEES procedure a fiberoptic nasolaryngoscope is inserted transnasally down to the level of the soft palate or lower. The dynamics of velopharyngeal closure are visible with movement of the lateral and posterior pharyngeal walls and the elevation and retraction of the soft palate during swallowing [3]. During the FFES procedure, there is a "white out" period when the pharyngeal walls and epiglottis cover the camera. Swallowing function can only be seen before and after the "white out" swallowing period.

The fiberoptic nasolaryngoscope was first used in the 1960's to examine structures in the laryngeal area and in the 1980s to assess dynamic voice production [4, 5]. In 1988, Langmore, Schatz and Olsen published the first article on FEES, addressing a need for a portable device to examine patients' swallowing function when the patient was not stable for transport to radiology for a Modified Barium Swallow Study (MBS) [6]. FEES became a complimentary diagnostic procedure to the MBS for evaluating a patient's swallowing function and in 1992 the American Speech-Language-Hearing Association (ASHA) included FEES in the scope of practice for speech-language pathologists [7].

In 1999, ASHA and American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) published a joint statement of the roles of speech-language pathologists and ear-nose and throat physicians (ENT) in performing and interpreting FEES [8]. In 2001, a CPT (Medicare) billing code for FEES reimbursement was assigned and ASHA established guidelines on competency and training for the FEES procedure [9]. In 2003, AAO-HNS requested that they be removed from the joint position statement, prompting the 2005 ASHA papers: *The Role of the Speech-Language Pathologist in the Performance and Interpretation of Endoscopic Evaluation of Swallowing: Position Statement* and *The Role of the Speech-Language Pathologist in the Performance and Interpretation of Endoscopic Evaluation of Swallowing: Technical Report*, which concluded that speech-language pathologists could independently perform FEES depending on the state by state restrictions [10, 11].

Currently, the training and competence guidelines included in the ASHA Endoscopic Evaluation of Swallowing Technical Report require ASHA certification, competence in the area of dysphagia practice, and sufficient training to demonstrate the knowledge and skills needed to perform and interpret FEES. In the technical report, ASHA recommends a three-step process for the acquisition of the technical skills involved in the FEES procedure including: 1) observation, 2) practice under direct supervision, and 3) independent practice with indirect supervision [12]. ASHA does not state a specific criterion at each step to assume clinician competence, but rather recommends that institutions develop a written list of competencies for performing FEES. Specific credentialing or privileging to perform FEES may be required by an institution or by speech-language pathology licensure laws individual states [10, 11]. The FEES position statement and technical report do not address the issue who (or what) should serve as a patient when the speech-language pathologist is at step 2, practice under supervision.

Related healthcare professionals, including nursing and medicine, utilize manikins for human simulation in the training of students [13]. Human simulation, which has been in existence since the 1960's, effectively facilitates healthcare workers' acquisition and proficiency of basic and advanced clinical skills [14]. Human patient simulators are used by approximately 30% of all medical schools in the United States, and at hundreds of medical centers, universities and colleges worldwide [13]. Medical centers and universities are also incorporating video-based training as an additional form of simulation for students [15]. The use of human simulation communicates the value of patient safety and makes training of healthcare professionals possible without compromising patients [16].

Human simulation, when included as a component of education, allows students to experience repetitive practice of the trained skill resulting in increased confidence, knowledge, and improved grades [14, 17]. When human simulation is integrated into clinical education, the focus shifts from the procedure to the student's competence in the performing the procedure. Students and faculty report high satisfaction with the incorporation of human simulation into the curriculum. Students' positive perceptions of the simulation training are consistent with their self-confidence ratings [17].

The use of simulation has the potential to allow speech-language pathology students, desiring endoscopy training, to gain experience with repetitive practice, bridging the steps of observation and practice under direct supervision, as recommended in the ASHA technical report, without compromising patients [12]. A challenge facing the field of speech-language pathology is how to adequately train students at the university level to acquire the endoscopy skills needed to perform FEES. The purpose of this study was to compare the time needed to

pass a fiberoptic nasolaryngoscope in multiple passes on standard patients, following two

different forms of training – human simulation and nonhuman simulation.

Participants

Eighteen graduate students in speech-language pathology (clinicians) who had completed a graduate level course in dysphagia within the past year and eighteen healthy adult female volunteers (standard patients), who self-reported no history of nasal trauma or surgery, served as standard patients. Participants gave written consent prior to participating in the study. Participants did not receive compensation for participation in the study. The study protocol was approved by Washington State University Institutional Review Board.

Instrumentation

Human Simulator

This study utilized human and nonhuman simulators. The human simulator was a laboratory modified G.H. Stoelting Company Scientific Apparatus an adult head and neck manikin mounted on a wooden frame attached to a standard office chair (Fig. 3) with the external nares 1333 mm above the floor. Inferior, middle, and superior nasal turbinates and vocal folds, respectively, were made of 2mm and 4 mm red and flesh colored Fibrecraft foam sheets and Loctite Liquid Super Glue and inserted in the manikin, simulating human adult structures when viewed through a flexible nasal endoscope.

Nonhuman Simulator

The non-human simulator was a 234 mm x 133 mm x 82 mm unopened standard medical glove box encased in factory applied protective plastic wrap positioned on a cart 1333 mm

distance above the floor. Two straight parallel lines, separated by 8 mm, were drawn with black marker across the width of the box, simulating a human adult nasal floor when viewed through a flexible nasal endoscope. A target, simulating vocal folds, was on the cart positioned immediately posterior and inferior to the box (Fig. 4).

Fiberoptic Nasolaryngoscope

The KayPentax Digital Swallow Station model 7200 Version 2.0 was used for simulation and standard patient scoping procedures. During the training, an older fiberoptic nasolaryngoscope Welch Allyn RL-150, no longer used with patients in the clinic, was used to prevent wear on current equipment.

The standard patients were scoped with a FNL-7RP3 fiberoptic nasolaryngoscope, utilizing an ultra-slim 2.4 mm insertion tube with a tapered distal tip, to minimize discomfort. The trials were recorded using the KayPentax Digital Swallow Station equipped with a Panasonic GP-KS162 camera.

To assess clinician manual dexterity, the Purdue Pegboard (1999) was used, which involves four subtests: right hand only, left hand only, both hands together, and assembly [18]. Scores are determined by the number of pins or pins, collars, and washers (assembly subtest).

Procedures

Training Day 1

The present study was conducted over two consecutive days. On day 1, all clinicians attended a 90 minute training session, which included two viewings of a laboratory-designed video of fiberoptic nasal endoscopy showing: 1) the use of the equipment, 2) hand positioning on the scope, 3) hand positioning on the patient, 4) an external view during the scoping procedure, and 5) an internal view (through the endoscope) during the scoping procedure. Live instruction

included: 1) an overview of FEES, 2) a review of anatomy and physiology of the pharyngeal and nasal structures, 3) observation of a scoping procedure using co-investigators, and 4) a ten-minute hands on session practicing hand positioning and scope feeding using flexible straws.

Nine clinicians were randomly assigned to a human simulation training group and nine clinicians were assigned to a nonhuman simulation training (control) group. Following the classroom training, the nine participants randomly assigned to the human simulation training group participated in seven passes of the fiberoptic nasolaryngoscope on the manikin. The nine clinicians randomly assigned to the nonhuman simulation training group participated in seven passes of the fiberoptic nasolaryngoscope on the glove box. Since there no standard is given for number of passes in training for FEES, seven passes was chosen as, in nursing, it is a standard for foundational skill acquisition (S. Kardong-Edgren, personal communication, April 2009).

Scoping Day 2

On day 2, each clinician completed the Purdue Pegboard to assess manual dexterity [18]. All clinicians scoped two standard patients. Each standard patient was scoped by one randomly assigned clinician from the human simulation training group and one randomly assigned clinician from the nonhuman simulation training group. The order of scoping, human simulation trained clinician first or second, for each standard patient was also randomly assigned. Clinicians were allowed three minutes from the time the scope entered the nares to the time the scope reached home position to remain in the study. Three minutes was the maximal length of pass time, as agreed on by the investigators, without causing undue patient discomfort.

All procedures on standard patients were video recorded on the KayPentax Swallow Station. The elapsed pass time was measured for each clinicians' first and second scope post data collection using "in" and "out" markers on the timeline on Final Cut Pro 6, a video editing

software program [19]. The "in" marker was placed beginning when the fiberoptic nasolaryngoscope entered the nares and the "out" marker was placed when the scope reached the home position, defined as the scope tip resting on the base of the tongue above the epiglottis with the vocal folds in view and centered in the monitor.

Elapsed pass time was calculated using two different measures. Total procedural time included all of the time from when the scope first entered the nares to when the scope reached home position, regardless of when the scope was withdrawn from the nose and reinserted because of the clinicians difficulty in visualizing the nasal passage. Total time in the nose included all of the time the scope was in the nose during single or multiple starts, but excluded all time the scope was withdrawn from the nose.

To evaluate confidence ratings, clinicians completed a nine question, Lickert scale survey and patients completed a six question, Likert scale survey, following each scoping procedure (Appendices A-D).

Statistical Analysis

A two-way analysis of variance (ANOVA) was used to test for significant differences across training groups, human simulation and nonhuman simulation, for elapsed pass times and Purdue Pegboard manual dexterity scores. A paired T-test was used to compare the clinicians' first transnasal endoscopy pass (Scope 1) from the second pass (Scope 2). Descriptive statistics are provided for duration measurements for elapsed time in the nose and total procedure time (Table 1). A Pearson Product Moment Correlation was used examine the relationships among simulation group, Scope 1 and Scope 2, and clinicians' Purdue Pegboard manual dexterity scores. An alpha level of 0.05 was set.

CHAPTER 3

RESULTS

Seventeen of the 18 graduate student clinicians were able to perform the transnasal endoscopy procedure, from entering the nares and reaching the home position, within a 3-minute time limit. One clinician (nonhuman simulation trained) was eliminated from the study due to inability to find home position after three minutes in the nasal cavity of a standard patient.

Clinicians performed the procedure faster between Scope 1 and Scope 2 in both the human simulation and nonhuman simulation group for Total Procedural Time ($t = 2.15$, $p < .05$) and for Total Time in the Nose ($t = 2.69$, $p < .05$).

For Total Procedural Time, there was no significant difference between clinicians trained with human simulation and clinicians trained using nonhuman simulation ($t = 0.50$, $p = .62$). For Time in the Nose, there was also no significant difference between clinicians trained with human simulation and clinicians trained using nonhuman simulation ($t = 0.28$, $p = 0.78$).

All clinicians performed within normal limits on the Purdue Pegboard on each assembly task. There was no difference across groups for the Purdue Pegboard subtests right hand only, left hand only, or both hands together. The human simulation group was faster than the nonhuman simulation group for the Purdue Pegboard assembly subtest ($t = 2.16$, $p <. 05$). There was no relationship between any manual dexterity subtests and Total Procedural Time or Total Time in the Nose.

Level of clinician confidence was related to Total Pass Time on Scope 2 ($r = - .50$, $p < .05$) and Total Time in the Nose on Scope 2 ($r = - .50$, $p < .05$) but not on Scope 1. There was

no significant difference in standard patient preference for clinicians trained using human

simulation or nonhuman simulation.

CHAPTER 4

DISCUSSION

The present study examined the effects of two different forms of training, human simulation and nonhuman simulation, on multiple transnasal endoscopic passes on standard patients, as measured by reduction in the time needed to pass a fiberoptic nasolaryngoscope and clinician and patient confidence ratings. The results of the study indicated no difference in pass times for clinicians trained using human simulation on a manikin and nonhuman simulation. These results have ramifications for speech-language pathology graduate programs considering offering training in transnasal endoscopy, as used in the FEES procedure. As there is no significant advantage in using human simulation manikins over nonhuman simulation, thereby eliminating the university program's need for purchasing a manikin for transnasal endoscopic training. A nonhuman simulation device, such as a glove box provides an adequate training device for the graduate student when bridging steps 1 and 2, observation and practice under direct supervision, during training.

Repetition has been shown to increase performance competence for medical procedures [20]. The importance of repetitive practice for transnasal endoscopy under direct supervision is evidenced by the faster pass times and increased confidence ratings between the first and second passes on standard patients.

Clinician confidence ratings increased for 1) instructions to the patient, 2) approaching the patient, 3) bracing on the patient, 4) inserting the fiberoptic nasolaryngoscope, 5) passing the scope past the nasal turbinates, 6) viewing the pharynx, 7) perceived patient comfort, 8) overall

procedure, and 9) procedural competence. According to the clinician surveys, 15 of the 17 clinicians reported greater confidence after performing Scope 2 as compared to after performing Scope 1. Clinicians who reported they were more confident approaching the patient and were more confident during the endoscopy procedure on the second pass of the fiberoptic nasolaryngoscope also demonstrated faster scoping times. This relationship suggests that as a clinician gains, greater confidence (as measured by qualitative self-reporting) in approaching their patient and overall confidence in performing transnasal endoscopy they become faster at scoping.

Faster scoping pass times are better predicted by clinician confidence than by manual dexterity. According to the ASHA Training Guidelines, speech-language pathologists must have necessary motor skills and aptitude needed to perform safe, effective endoscopy procedures [21]. The Purdue Pegboard was included in the present study, after students in a graduate course on dysphagia expressed concern about the perceived degree of coordination required to operate a fiberoptic nasolaryngoscope. All clinicians in the present study demonstrated adequate motor skills by scoring within normal limits on the Purdue Pegboard test. Although the human simulation group was faster as compared to the nonhuman simulation group in the assembly task, which involved manipulating pegs, washers, and collars, this improved performance did not transfer to increased speed in scoping. Manual dexterity was not a predictor for faster scoping times, as evidenced by the lack of relationship between individual manual dexterity scores and pass times for Scope 1 or Scope 2.

A limitation of this study is that a second control group without simulation training was not included. Prior to the present study this option was considered, but rejected due to the risk of patient compromise secondary to the limited clinical experience of graduate students.

The advantage of gaining foundational procedural knowledge in passing a fiberoptic nasolaryngoscope during graduate school is that students will enter the medical field ready to transfer their endoscopy skills to the FEES procedure, which is included in the scope of practice for speech-language pathologists.

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Table 1

Time in the Nose by simulation training group and time differences for Scope 1 and Scope 2

Simulation Training Group	Scope 1 (seconds)	Scope 2 (seconds)	Differences (seconds)
Human Simulation			
HS C1	62.26	29.12	33.14
HS C2	122.28	148.02	-25.74
HS C3	74.18	31.14	43.04
HS C4	45.40	45.36	0.04
HS C5	41.32	58.52	-17.20
HS C6	167.52	142.44	25.08
HS C7	98.36	42.44	55.92
HS C8	138.40	51.24	87.16
HS C9	101.32	66.32	35.00
Mean for HS	94.56	68.29	26.27
Nonhuman Simulation			
NHS C1	31.22	32.20	-0.98
NHS C2	70.26	96.46	-26.20
NHS C3	79.28	36.44	42.84
NHS C4	133.10	76.00	57.10
NHS C5	133.24	61.24	72.00
NHS C6	81.06	78.22	2.84
NHS C7	93.08	48.48	44.60
NHS C8	92.32	120.28	-27.96
Mean for Nonhuman Simulation	89.20	68.67	20.53
Total Mean	92.04	68.47	23.57

HS: Human Simulation
NHS: Nonhuman Simulation
C: Clinician

Table 2

Total Procedural Time by simulation training group and time differences for Scope 1 and Scope 2

Simulation Training Group	Scope 1 (seconds)	Scope 2 (seconds)	Differences (seconds)
Human Simulation			
HS C1	62.26	29.12	33.14
HS C2	310.16	282.54	27.62
HS C3	134.18	31.14	103.04
HS C4	45.40	107.16	-61.76
HS C5	41.32	58.52	-17.20
HS C6	167.54	160.28	7.26
HS C7	98.36	42.44	55.92
HS C8	138.40	51.24	87.16
HS C9	101.32	66.32	35.00
Mean for HS	122.10	92.08	30.02
Nonhuman Simulation			
NHS C1	31.22	32.20	-0.98
NHS C2	70.23	99.46	-29.23
NHS C3	182.12	36.44	145.68
NHS C4	125.40	76.00	49.40
NHS C5	148.14	61.28	86.86
NHS C6	95.46	78.22	17.24
NHS C7	98.26	48.48	49.78
NHS C8	92.32	167.52	-75.20
Mean for Nonhuman Simulation	105.39	74.95	30.44
Total Mean	113.75	83.52	30.23

HS: Human Simulation
NHS: Nonhuman Simulation
C: Clinician

Figure 1

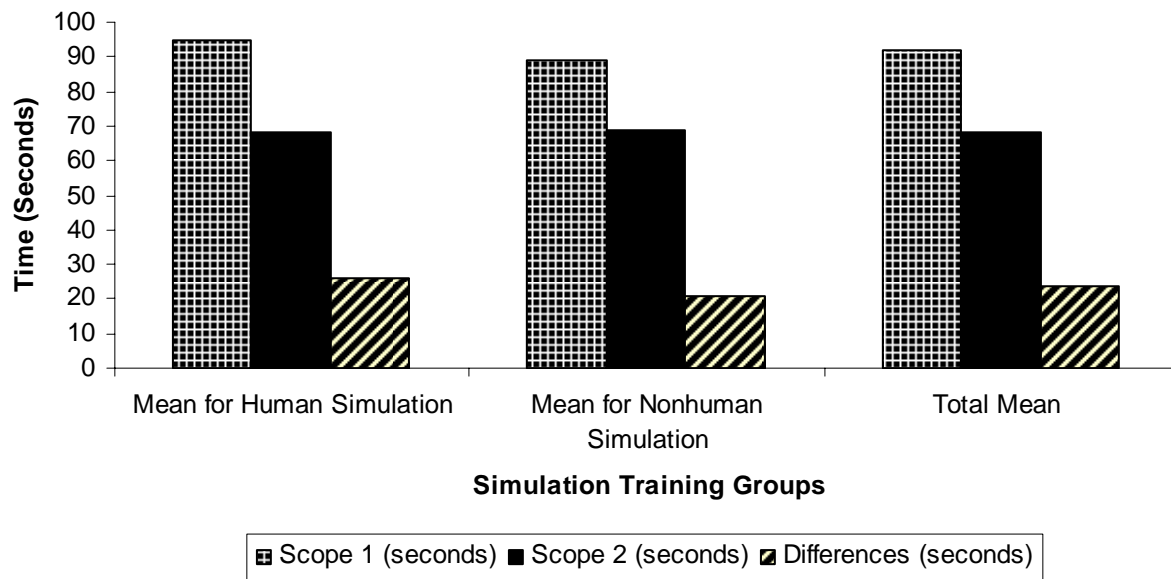Differences by simulation training group for Time in the Nose

Figure 2

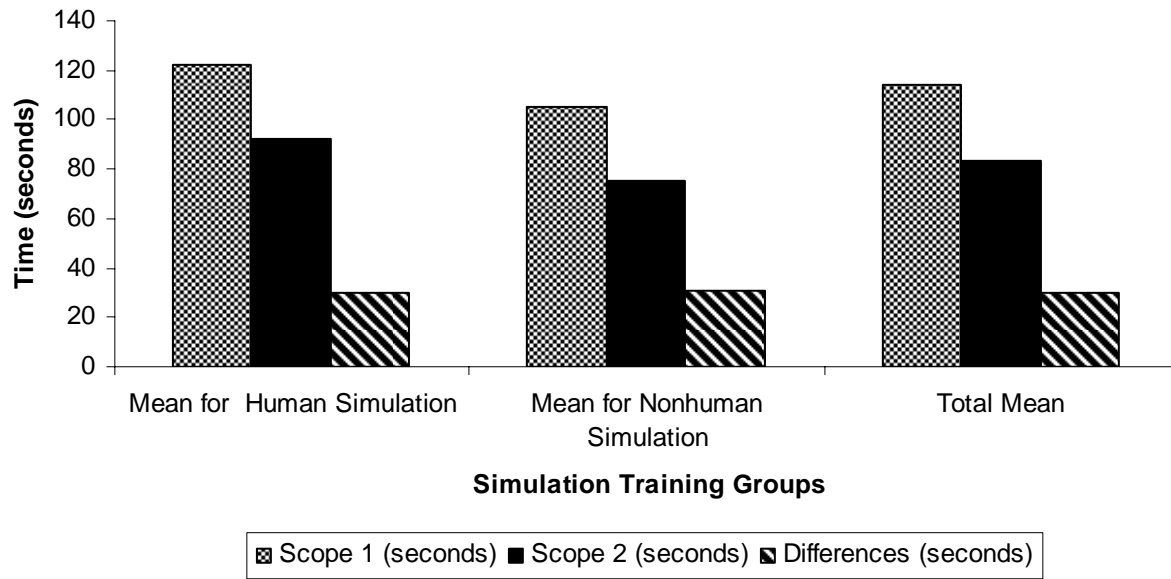Differences by simulation training group for Total Procedural Time

Figure 3

Human simulation manikin

Figure 4

Nonhuman simulation device

APPENDIX A. CLINICIAN SURVEY FOLLOWING SCOPE 1

Survey of fiberoptic nasal endoscope experience
For each question circle only one response

1. I was clear in my instructions to the patient.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

2. I was confident in approaching the patient.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

3. I was competent in bracing my hands on the patient.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

4. I was confident inserting the endoscope into the patient's nose.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

5. I was competent in passing scope past the nasal turbinate.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

6. I was competent in viewing the pharynx.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

7. The patient was comfortable during the procedure.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly Agree

8. I was confident in my ability to pass the scope on the patient.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly Agree

9. I was competent in passing the scope on this patient.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly Agree

Comments:

APPENDIX B. CLINICIAN SURVEY FOLLOWING SCOPE 2

Survey of fiberoptic nasal endoscope experience
For each question circle only one response

1. I was clear in my instructions to the patient.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

2. I was confident in approaching the patient.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

3. I was competent in bracing my hands on the patient.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

4. I was confident inserting the endoscope into the patient's nose.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

5. I was competent in passing scope past the nasal turbinate.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

6. I was competent in viewing the pharynx.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

7. The patient was comfortable during the procedure.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly Agree

8. I was confident in my ability to pass the scope on the patient.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly Agree

9. I was competent in passing the scope on this patient.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly Agree

10. I felt more confident passing the scope on:

_____ The first patient or _____ The second patient   Comment:

APPENDIX C. PATIENT SURVEY FOLLOWING SCOPE 1

Survey of fiberoptic nasal endoscope experience
For each question circle only one response

1. The clinician was clear in giving instructions.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

2. The clinician was confident in approaching the patient.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

3. The clinician was confident inserting the endoscope into the patient's nose.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

4. The procedure was comfortable.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly Agree

5. The clinician was confident throughout the scoping procedure.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly Agree

6. The clinician was competent throughout the scoping procedure.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly Agree

APPENDIX D. PATIENT SURVEY FOLLOWING SCOPE 2

Survey of fiberoptic nasal endoscope experience
For each question circle only one response

1. The clinician was clear in giving instructions.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

2. The clinician was confident in approaching the patient.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

3. The clinician was confident inserting the endoscope into the patient's nose.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly

4. The procedure was comfortable.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly Agree

5. The clinician was confident throughout the scoping procedure.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly Agree

6. The clinician was competent throughout the scoping procedure.

(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, (5) Strongly Agree

7. If you were to be scoped again which clinician would you prefer?

The first _____ The second _____