Lecture 3

FEES Protocols

Equipment

- Laryngoscope: fiberoptic or distal chip
- Light source: halogen or xenon Or LED
- Camera
- Recording device: computer, DVD
  - For playback, need frame by frame slow motion feature
- Audio input/ microphone
- Monitor
- Cart

- Total cost: $16,000 to $160,000
- Olympus & Pentax most common companies in US
- Other great companies: EndoHD, JedMed, Storz, Atmos

Fiberoptic Laryngoscope

Distal Chip HR Scope

Food ideas

Milk
plus green food color

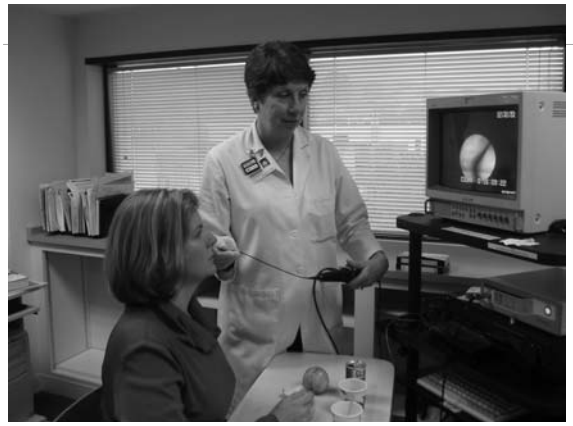
White food color/icing- add to water- plus green food color

5mL = 4 drops, 15 mL=8 drops, 2oz= approx16 drops, 3oz = more drops (until the liquid is green)

Typical ENT Positioning for a FEES

OP Patient Positioning

Ideal OP positioning

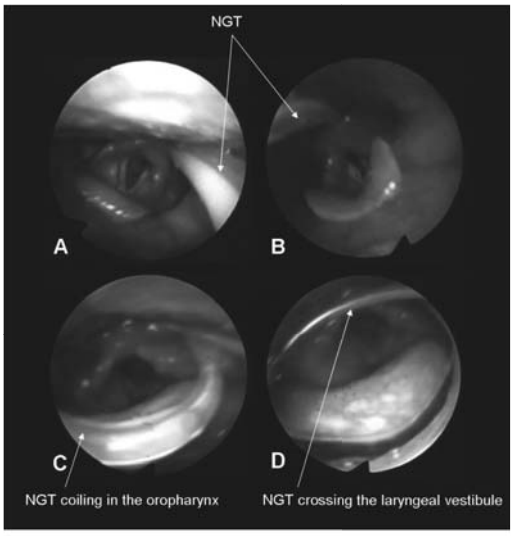


Inpatient Exam

Inpatient – better Positioning

Question: Does the presence of a scope interfere with/ hinder swallowing/

- Several studies: most say NO
- 1. Dziewas R, Do nasogastric tubes worsen dysphagia in patients with acute stroke? 2008
  - 25 patients with FEES scope in place
  - Compared swallow with & without an NGT
  - Results: correctly placed NGT did not worsen dysphagia; incorrectly placed NGT did increase penetration (see figure next slide)
- 2. Suiter DM, Moorhead MK. Effects of flexible fiberoptic endoscopy on pharyngeal swallow physiology, 2007.
  - 14 patients examined via fluoro, with & without a scope in place
  - Results: NO difference (timing, PAS, residue.



igure 1
fferent types of NGT position. A) Normal position along the lateral pharyngeal wall; B) Medial position with variable contact
o the arytenoids; C) NGT coiling in the oropharynx; D) NGT coiling in the hypopharynx with crossing the laryngeal vestib

One contrary study

3. Adachi, K.(2017) Videoendoscopy worsens swallowing function: a videoendoscopy study; a RCT.
  - 37 patients given fluoro, with/ without endoscope in place
  - Results: PAS worse; residue score worse; laryngeal elevation delay time – no difference

- WHY THE DISCREPANCY?
- Adachi = no mention of # of boluses or blinding of raters
- Dziewas = detailed info on # of boluses and blinding of raters (multiple boluses)
- Suiter = 10ml boluses x2 blinded raters; IRR established

Definition of FEES™ Protocol

Three Parts:

1. Assess anatomy, physiology of structures in view
2. Assess swallowing of food, liquid
3. Assess response to therapeutic intervention

PART 1: ANATOMIC-PHYSIOLOGIC ASSESSMENT

A. Velopharyngeal Closure

Task: Say "ee", "ss", other oral sounds; alternate oral & nasal sounds ("duh-nuh")
Task: Dry swallow
Optional task: Swallow liquids and look for nasal leakage

B. Appearance of Hypopharynx and Larynx at Rest

Scan around entire HP to note symmetry and abnormalities that impact swallowing and might require referral to otolaryngology or other specialty.
Optional task: Hold your breath and blow out cheeks forcefully (pyriform sinuses)

C. Handling of Secretions and Swallow Frequency

Observe amount and location of secretions and frequency of dry swallows over a period of at least 2 minutes.
Task: If no spontaneous swallowing noted, cue the patient to swallow
Go to Ice Chip Protocol if secretions in laryngeal vestibule or if no ability to swallow saliva.

D. Base of Tongue & Pharyngeal Muscles

1. Base of Tongue:
Task: Say 'earl, ball, call' or other post-vocalic - 'l' words

2. Pharyngeal Wall Medialization
Task: Screech; hold a high pitched, strained 'ee'
(Task: see laryngeal elevation task below)

E. Laryngeal Function

1. Respiration
Observe larynx during rest breathing (respiratory rate; adduction/abduction)
Tasks: Sniff, pant, or alternate "ee" with light inhalation (abduction)

Phonation
Task: Hold "ee" (glottic closure)
Task: Repeat "hee-hee-hee" 5-7 times (symmetry, precision)

Elevation
Glide upward in pitch until strained; hold it (**pharyngeal walls** also recruited)

Airway Protection
Task: Hold your breath lightly (true vocal folds)
Task: Hold your breath very tightly (ventricular folds; arytenoids)
Task: Hold your breath to the count of 7
Optional: Cough, clear throat, Valsalva maneuver

F. Sensory Testing

Note response to presence of scope
Optional task: Lightly touch tongue, pharyngeal walls, epiglottis, AE folds
Optional task: Perform formal sensory testing with air pulse stimulator
**Note: Additional information about sensation will be obtained in Part II and formal testing can be deferred until the end of the examination if desired.

PART II: SWALLOWING OF FOOD & LIQUID. All foods / liquids dyed green or blue with food coloring.

Consistencies
To try will vary depending on patient needs and problems observed. Suggested consistencies to try:

- Ice chips – usually 1/3 to 1/2 teaspoon, dyed green
- Thin liquids – milk, juice, formula. Milk or other light-colored thin liquid is recommended for visibility. Barium liquid is excellent to detect aspiration, but retract the scope to prevent gunking during the swallow.
- Thick liquids – nectar or honey consistency, milkshakes
- Puree
- Semi-solid food – mashed potato, banana, pasta
- Soft solid food (requires some chewing) – bread & cheese, soft cookie, casserole, meat loaf, vegetables
- Hard, chewy, crunchy food – meat, raw fruit, green salad
- Mixed consistencies – soup with food bits, cereal with milk

Amounts / Bolus Sizes
If measured bolus sizes are given, a rule of thumb that applies to many patients is to increase the bolus size with each presentation until penetration or aspiration is seen. When that occurs, repeat the same bolus size to determine if this pattern is consistent. If penetration / aspiration occurs again, do not continue with that bolus amount. The following progression of bolus volumes are suggested:

- < 5 cc if pt is medically fragile and/or pulmonary clearance is poor
- 5 cc (1 teaspoon)
- 10 cc
- 15 cc (1 tablespoon)
- 20 cc (heaping tablespoon, delivered)
- Single swallow from cup or straw – monitored
- Single swallow from cup or straw – self-presented
- Free consecutive swallows – self-presented
- Feed self food at own rate

The FEES® Ice Chip Protocol

Part I: Emphasize anatomy, secretions, laryngeal competence, sensation
- Note spontaneous swallows, cued swallow

Part II: Deliver ice chips
- Note effect on swallowing, effect on secretions, cough if aspirated

Standard FEES Exam: Part 1

Assessing anatomy, secretions, movement of structures in view

Part 1 – Assess Anatomy

› Pathology suspected? If so, refer to ENT.

› Supportive for swallowing?
- Are there open channels for the bolus to spill, flow, and for residue?
- What will the path of the bolus be?

Part 1 – Assess Anatomy

› Example: Epiglottis on base of tongue is NOT supportive

Part 1 – Assess Anatomy

› Epiglottis up: supportive? non-supportive?

Appearance of Secretions: Handling of Secretions

› Amount, appearance of secretions

› Location and patient response
- ❖ 0 = normal
- ❖ 1 = outside laryngeal vestibule
- ❖ 2 = transient pooling in vestibule but patient clears them
- ❖ 3 = consistent pooling in vestibule with no ability to clear

❖ Murray et al, 1966 The significance of accumulated oropharyngeal secretions and swallowing frequency in predicting aspiration. Dysphagia 1996

Swallow Frequency

› Note frequency of spontaneous swallow

› Normal = 2-3 per minute with scope in place

› If no spontaneous swallows, ask patient to swallow

Part 1 – Assess Physiology & Movement

› Structures to assess
- – Velopharynx
- – Base of tongue
- – Pharynx
- – Larynx

› Parameters to assess
- – Symmetry of movement
- – Range of movement
- – Speed of movement
- – Precision of movement

Part 1 – Assess Physiology & Movement

<u>Velopharyngeal port (assess before passing into HP)</u>

What to Assess

› Velar elevation and lateral wall movement

Tasks

› Phonation (oral sounds) “pa-pa-pa” “ssss” “50-50-50”

› Swallow

Part 1 – Assess Physiology & Movement

<u>Base of Tongue retraction to pharyngeal walls</u>

What to Assess in Part 1

› Symmetry & bulk

› Retraction towards posterior pharyngeal wall

Tasks

› Speech: post-vocalic “l” words in American English (Al, pal, ball, all, awful, careful, bottle)

Part 1 – Assess Physiology & Movement

Pharyngeal squeeze – medialization of lateral walls

What to Assess

› Longitudinal & constrictor muscles
› Extent of movement; symmetry
› Lateral wall medialization

Tasks

› High-pitched effortful tight “ee”; hold it out

Part 1 – Assess Physiology & Movement

Larynx: Respiration

What to Assess

› Respiratory rate, movement of VC/arytenoids

Tasks

› Observe breathing
› Sniff, quick inhalation to see VC abduction/ airway opening adequate?

Part 1 – Assess Physiology & Movement

Larynx: Phonation

What to Assess

› Symmetry, mobility, amplitude, precision, speed of vocal fold and arytenoid movement

Tasks

› Hold out “ee”
› Repeated “hee, hee, hee” (adduction/abduction)
  – Tests symmetry, mobility
› Glide up in pitch (extrinsic laryngeal elevators)
  – VC lengthen; Arytenoids lift

Part 1 – Assess Physiology & Movement

Larynx: Airway Protection

What to Assess

› Completeness, briskness, ease to maintain airway closure *at the level of the glottis*

Tasks

› Hold breath lightly
› Hold breath tightly
› Sustain breath hold to count of 7
› Cough, clear throat
› If patient not participating, rate this from voicing, cough, etc.

How to Choose among Part 1 Tasks

ALWAYS EVALUATE

› Anatomy: symmetry
› Secretions
› Vocal fold mobility
› Glottic closure/ airway protection
› Sensation/ sensory awareness

ONLY VALID IF PT CAN COOPERATE

› Laryngeal excursion; glide up in pitch
› Precision, speed of VF movement
› Pharyngeal squeeze
› Base of tongue retraction

VIDEO 1:

Joe Protocol (stop at end of Part 1)

› Protocol: Part 1.
  – Normal subject

Assessment of Sensation

› Really an assessment of sensori-motor system: behavioral/motor response to sensory stimulus

› Done throughout the study via observation of patient response

› Can be assessed directly at the end of the study… IF in question

Assessment of Sensation

How to Evaluate Sensory Awareness?

› Patient behavior
- Response to scope
- Response to penetration, aspiration, residue

› Formal Testing of Sensation:
- FEESST protocol to measure sensory threshold
- Direct touch to the larynx

Should you do formal Sensory testing?

FEESST Protocol (Aviv, 1996)*

› FEESST = Fiberoptic Endoscopic Evaluation of Swallowing with Sensory Testing

*Aviv JE, Martin JH, Sacco RL, et al. Supraglottic and pharyngeal sensory abnormalities in stroke patients with dysphagia. *Ann Otol Rhinol Laryngol.* 1996;105(2):92-97.

FEESST Protocol (Aviv, 1996)

› Air pulse delivered through a catheter within the scope, next to the light channel

› Air pulse delivered to the mucosa over the AE fold at certain air pressure level. (2 - 10mm of Hg)

› Watch for brief VC adduction (LAR)

› Laryngeal Adductor Reflex
- Stimulate mucosal surface in the HP → up the SLN to the brainstem
- Synapse with the RLN → motor response to the TVC
- TVC adduct briefly = LAR

Two Methods of Sensory Testing

	Air Pulse Method	Touch Method
Main use	research	clinical
Equipment	air pulse stimulator (Pentax AP- 4000) channel scope (FNL10-/13RAP) 	regular endoscope 
Stimulation	air pulse, 2-10 mmHg, 50 ms	light touch
Test sites	arytenoids	arytenoids, the tip of epiglottis
Responses	The Laryngeal Airway Reflex (the LAR)	The LAR, subject report, cough, gag, swallows, etc.
Measurements	4 mmHg < normal (Aviv, 1997)	present / absent (Langmore, 2001)

Kaneoka: Compared Two Sensory Tests

– Assess the ability of each exam to detect laryngeal sensory deficits
– Determine the association between sensory deficits and penetration/aspiration

*Kaneoka A, Krisciunas GP, Walsh K, Raade AS, Langmore SE. A Comparison of 2 Methods of Endoscopic Laryngeal Sensory Testing: A Preliminary Study. *Ann Otol Rhinol Laryngol.* 2014.

Study: Comparing Two Sensory Tests (Methods)

Patients:

5 Healthy Adults Age ≥ 50 EAT10 < 3	5 Parkinson's Disease (PD) Patients with dysphagia EAT10 ≥ 3	6 Post-Radiation Head & Neck Cancer (HNC) Patients with dysphagia EAT10 ≥ 3

Evaluation:

› FEES performed
› PAS recorded
› 2 Sensory tests performed in series
1. Air Pulse
2. Touch

Results:

1. The **Air Pulse method** identified laryngeal sensation deficits more frequently than the touch method.

But *too many subjects* scored as impaired from the air pulse test – required stronger air pressure - some normal controls tested abnormal

Low specificity

And No significant association with PAS

2. Better sensitivity and specificity from the **Touch Test**

Laryngeal sensory loss revealed by the touch method *was significantly associated with increased PAS score.*

= a stronger stimulus; most subjects respond ; if don't respond, indicates definite sensory loss

Follow up PhD project - Kaneoka (2017)

› 61 inpatients
› Compared response to touch and +/- penetration or aspiration
› Results:
– No significant association between touch test results and penetration/aspiration!
– BUT Significant association was found between touch test results and development of pneumonia!

› My conclusion: The jury is still out.....we can't rely on touch test alone to predict penetration and aspiration

Sensory Testing Air Pulse Touch (Mike)

› Demonstration of Air Pulse test and Touch Test on normal subject

FEES Exam: Part 2

FEES Exam: Part 2

› Part 2 involves swallowing food and liquid

› While Part 2 can be "standard", it can also be tailored depending on the patient population, severity of the problem, reason for the exam, etc.

Advantages of FEES: Part 2

› For all protocols: consistencies

› Real food is a "physiologic bolus" – provides real taste, real appearance – is always an advantage

› Ideal dysphagia tray includes…
- Thin/clear liquid
- Nectar
- Puree
- Semisolid
- Dry food (cracker)
- Mixed food (fruit cocktail)
- Regular/hard

› Pills are optional

Advantages of FEES Exam: Part 2

› For all protocols, patient, family, and/or hospital staff/MD/ RN may be involved during the exam!

- All can see the monitor
- Therapy intertwined with the evaluation
- Education about what is happening
- Joint decision making

Different Kinds of FEES exams

› **Structured/ Standard exam** (same bolus sizes, consistencies)
- The examiner directs the patient
- Good to compare same patient from one exam to the next

› **Customized exam** (variations from Standard Protocol)

› OR **Combination**: start with structured bolus sizes, then let the patient eat normally

Standard FEES Exam: Part 2

› The standard exam involves a progression of bolus consistencies & volumes

My guidelines:

› Neurologic (not severe, not a high risk for aspiration pneumonia): start with pureed, then liquids

› Non-neurologic: start with liquids, then food

› Liquid volumes
- Start with 5ml unless high risk for aspiration
- Increase quickly if OK; up to consecutive cup drinking

2 optional short videos

MG cracker_1.mov –(first bite)

Compare this to MG cracker _4.mov) (4th bite)

Other Types of Exams

› Functional:

› Perform FEES with patient in bed – if that is how he will eat!

› Perform exam to determine if patient needs supervision (is he careful? Does he respond to residue?)

Customized:

› See if fatigue is affecting swallowing ability
- Perform the FEES exam after patient has eaten for awhile, or do a longer exam to induce fatigue
  - › Good for patients with possible myesthenia gravis, COPD

VIDEO

Amy protocol

Joe.Protocol (– continue same video to end)

Demonstration of Part 2 of FEES on normal SLPs

1. **Structured exam** done on SLP student (Amy)
   - thin liquid, applesauce, cracker
   - Subject takes a single bite/sip at a time

2. **Unstructured/Functional** exam done on SLP (Joe)
   - Susan announces the bolus as the subject freely eats and drinks

Part 3 of FEES Exam: Try Therapeutic Interventions to see if they improve the safety or efficiency of the swallow

Choose from

- Compensatory interventions
- Rehabilitative interventions

The intervention is based on the specific problem you have observed

What About Severe, High Risk Patients?

› If currently NPO or high risk for aspiration, do a more conservative exam.

› Control bolus sizes, rate of delivery, etc from the start of the exam.

› Ideal for ICU patients.

“Conservative FEES Exam” - Ice Chip Protocol

Ice Chip Protocol - Patients

› Appropriate for a patient who…
- Is at high risk of aspirating
- Has not eaten orally for weeks or months
- Is not handling oral secretions (drooling)
- Has an active pneumonia or compromised lung clearance
- May have a very weak swallow or no swallow at all!

Ice Chip Protocol

Why are ice chips a good stimulus???
- Easier to control than water
  - (spillage into HP)
- Stimulates the oral preparatory phase
  - Masticate, prepare the bolus
    - → sensory pathways to cortex→ stimulates a stronger, quicker swallow
- A highly salient bolus
  - Activate sensory receptors: temperature, touch, pressure (texture), taste
- Water is the safest material possible to aspirate

Ice Chip Protocol: the Steps

- Assess vocal fold mobility, anatomy
- Assess secretions (aspirated?) and patient response to secretions
- Ask patient to 'dry swallow'/ swallow his secretions
- Deliver ice chips – "Take 1 or 2, chew/ move around in your mouth and swallow them all at once"
- Did they facilitate and/or stimulate swallowing?
  - if a swallow occurred, were the secretions reduced?
- Repeat these steps for 3+ ice chip trials

Ice Chip Protocol

- "Warm-up time" is common: 2-5 ice chips given before seeing improvement
  - You should see a brisker swallow within minutes
  - Re-evaluate after each trial
  - If some positive response, continue with more ice chips
  - But if no swallows after 3 trials of ice chips, then consider stopping
- Obtain some diagnostic information
  - Is the swallow weak or just "disused"?

Outcomes of the Ice Chip Protocol

- Determine if patient can begin to transition from NPO to oral intake.
- Usual recommendations after exam: continue with ice chips for several days?
  - Encourage frequent swallowing of ice chips
  - Patient may regain strength over days or weeks
  - Re-evaluate periodically: ready to move to food?
- If very good response, can begin other consistencies right away – in the same exam??

Ice Chip Protocol – Case Study

- ICU patient
- NPO for months – but NGT still in place
- Complex patient with multiple medical problems
- Recently weaned off vent
- Has tracheostomy – has speaking valve on during exam
- Exam done bedside

VIDEO:

Ice Chip Protocol (2min 24sec)

(or 7 min version)