FEES: as a Tool to Evaluate and Treat Patients with Dysphagia

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Anatomy; normal swallowing viewed endoscopically; Indications for FEES vs Fluoroscopy

Agenda for today

- Overview, Anatomy, Physiology of Normal Swallow, indications for FEES vs Fluoroscopy
- FEES protocols; standard and customized
- FEES Scoring systems and Interpretation
- Treatment and Management guided by FEES; Risks and Safety of the Procedure

Most common evaluation tools for evaluating oropharyngeal dysphagia

- **Clinical Examination**
- **Fluoroscopy** (Modified Barium Swallow) (MBS)
- **FEES** – Fiberoptic Endoscopic Evaluation of Swallowing
- **Manometry** – improvements in past 5 years; used more and more

Every Exam Has Its Limitations!

- No examination is complete or best for every patient
- The ideal clinic: you could choose from all 4

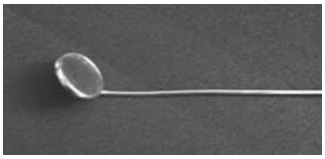
A Short History

- Fluoroscopy developed first: late 1970s, 1980s (Logemann)
- FEES first published in 1988 (Langmore)
- First use of FEES: if fluoroscopy cannot be done
- Today – established procedure, performed throughout the US and many other countries
  - Egypt, India, Hong Kong, Thailand(?) Saudi Arabia, all of Europe, Australia, Argentina, Brazil, Chile, Canada, Mexico
- Fluoroscopy is no longer the preferred procedure; *sometimes FEES is preferred.*

Technology has Advanced the Value of FEES

A Short History of FEES

Early Days



The mirror & eyepiece had limitations…

A Short History of FEES

Cameras and Recording!

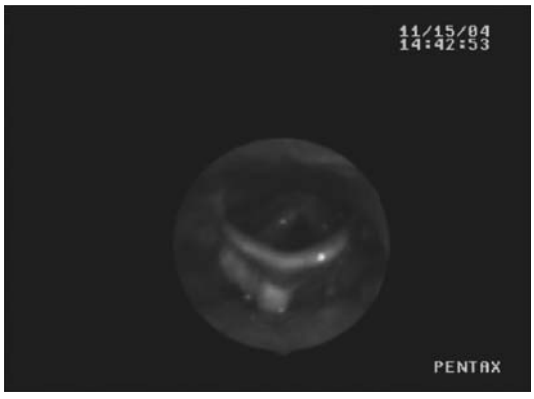
"We can all see the aspiration!"

Modern FEES sytems

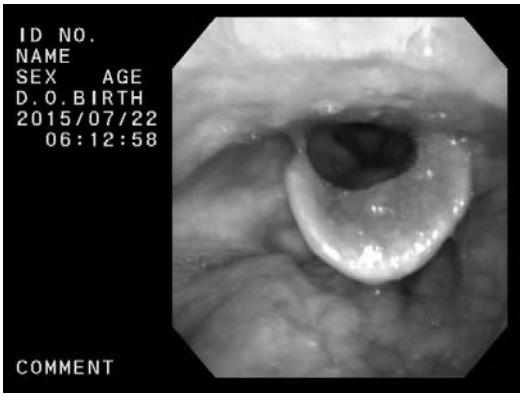
LARGER FEES SYSTEM

PORTABLE SYSTEM

Early systems; dark, small image

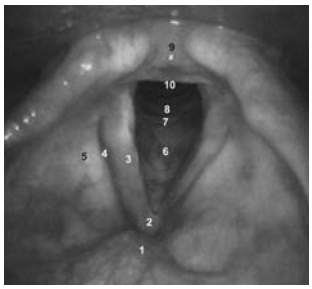


High resolution, distal chip laryngoscope



Anatomy, Physiology, and the Normal Swallow

Anatomy



Endoscopic Anatomy Key

OVERVIEW/ HOME POSITION

1. Base of tongue
2. Valleculae
3. Pharyngeal-epiglottic ligament
4. Piriform sinus
5. Posterior pharyngeal wall
6. Arytenoid
7. Aryepiglottic fold
8. Epiglottis
9. False vocal folds
10. True vocal folds
11. Anterior Commissure
12. Sub-glottic space

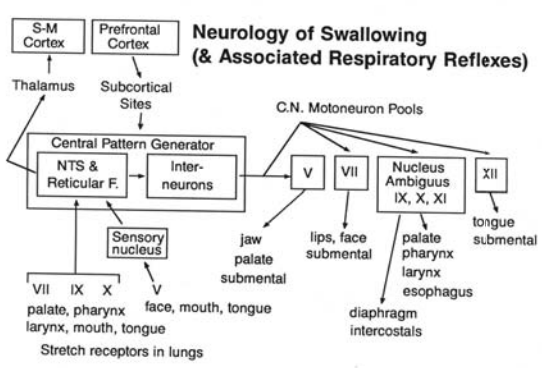
CLOSE UP VIEW

1. Petiole of epiglottis
2. Anterior commissure
3. True vocal fold
4. Ventricular space
5. False vocal folds
6. Subglottic shelf
7. Edge of the Cricoid
8. Tracheal ring
9. Interarytenoid space
10. Posterior commissure

Normal Swallowing

- Swallowing is a complex patterned reflex,
- involving multiple levels of neural processing
- and 50+ paired muscles contracting in a finely timed and rapid sequence.

Normal Swallowing



The Normal Swallow: What Can be Seen Endoscopically (and Fluoroscopically?)

Oral Stage / Preparing the bolus- prior to swallow

Movement	FEES	Fluoroscopy	Clinical observation
Tongue, lip movements – prepare the bolus (chew); no leakage out of mouth	Poor	Good	Very good
Bolus leaks or is thrust into hypopharynx (HP)	Excellent	Good (if xray turned on)	No

Onset of the Swallow – Many movements occur nearly simultaneously

Movement	FEES	Fluoroscopy	Clinical observation
Arytenoids move medially, anteriorly	Good - when seen/ inconsistent	Fair	No
Tongue base retracts, thrusts the bolus into HP	Partial view	Good	No
Velopharyngeal closure	Excellent	Partial view	No

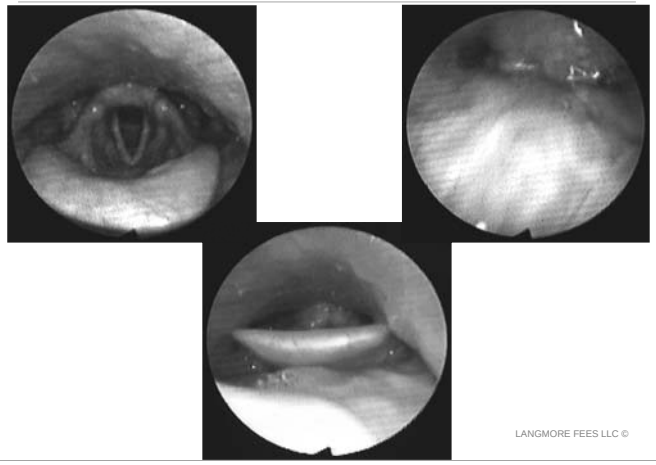
Onset of the Swallow – more movements

Movement	FEES	Fluoroscopy	Clinical observation
Hyoid and larynx - superior and anterior movement	No	Good	Poor (estimate by palpation)
Epiglottis retroflexes	Fair	Good	No
Vocal folds close	No	Partial (in anterior/ posterior view)	No

Onset of swallow – more movements

Movement	FEES	Fluoroscopy	Clinical observation
Lateral pharyngeal wall-medial squeeze	Partial view; sometimes good	Poor	No
UES opens	No	Good	No
Bolus may be seen if any spillage	Good	Good	No

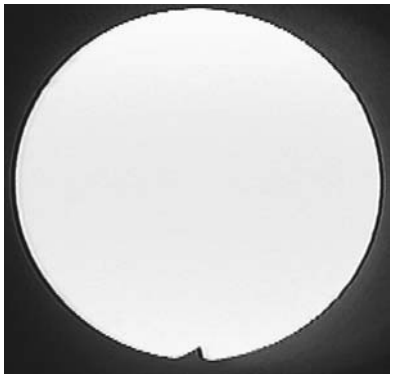
Onset of the Swallow: FEES view



At Height of the Swallow

Movement	FEES	Fluoroscopy	Clinical observation
Bolus moves through HP	No	Good	No

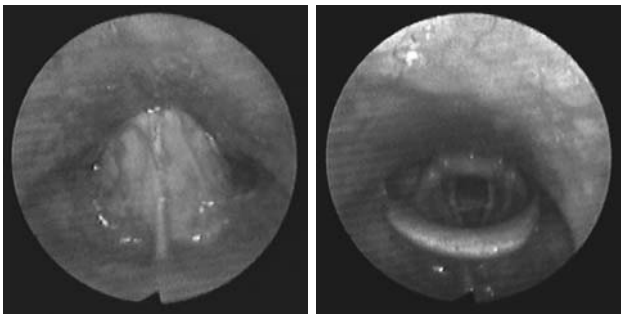
At Height of the Swallow – FEES view



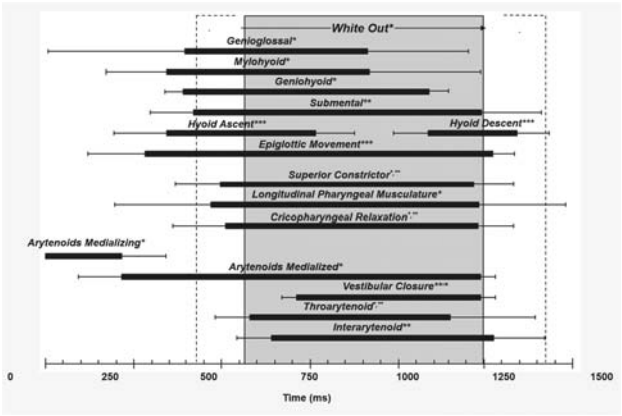
After the Swallow

Movement	FEES	Fluoroscopy	Clinical observation
All structures return to rest	Can see epiglottis, Velopharynx re-open	Can see most movements (except vocal folds)	No

After the Swallow – don't forget Manual light setting



Physiology: Timing during a Swallow



3 phases:

1. Tongue preparation and propulsion – bolus appears
2. timed with

› Arytenoid medialization/anterior movement

2. Hyolaryngeal excursion/ epiglottis retroflextion

3. Pharyngeal squeeze/ tail of bolus

timed with

› UES opening and bolus moving through UES

What about Soft Palate?

› It elevates just before the bolus moves posteriorly in the mouth

› Actually the FIRST movement of the swallow

- VP closure is not seen endoscopically unless you pull into the nose
- Be sure to pass the tip of the scope beyond the velum or you will be pulled up as the soft palate elevates - and lose the view early to white out

VIDEO

FEES Water Swallows

1 min

› Endoscopic view of Water Swallows (1min)

VIDEOS

Simult Normal.1.43

Simul patient .ID 29 liquids

Simultaneous MBS & FEES videos of swallows

1 Healthy normal subject

2 Patient with dysphagia – swallowing liquids

How Does the Airway Close for Breath hold vs. Swallow?

Conventional View

› Airway closure for swallow = same as breath hold

› Inferior-to-superior closure
  – TVC, FVC first, arytenoids, epiglottis

› BUT, this is NOT TRUE!

Studies of Airway Closure for Swallowing showing airway closure is different for swallowing vs breath holding

*Van Daele DJ, McCulloch TM, Palmer PM, Langmore SE. Timing of glottic closure during swallowing: a combined electromyographic and endoscopic analysis. Ann Otol Rhinol Laryngol. 2005;114(6):478-487.

Endoscopy, and intramuscular EMG recorded simultaneously to study airway closure.

Supporting research:

Flaherty RF, Seltzer S, Campbell T, Wisskoff RM, Gilbert RJ. Dynamic Magnetic Resonance imaging of vocal cord closure during deglutition. Gastroenterology 1995: 109:843-849.

Ohmae Y, Logemann JA, Kaiser P, Hanson DG, Kahrilas PJ, Timing of glottic closure during normal swallow. Head Neck 1995:17: 394-402.

Airway Closure for Breath Holding

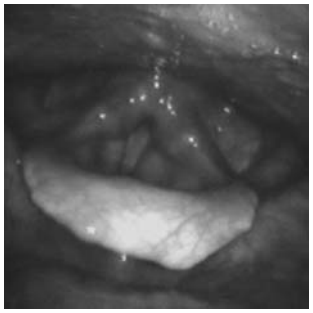
Light Breath Hold:

› At level of larynx

› TVC actively adduct

› Arytenoids medialize

› Remember, breath hold can occur without laryngeal closure!

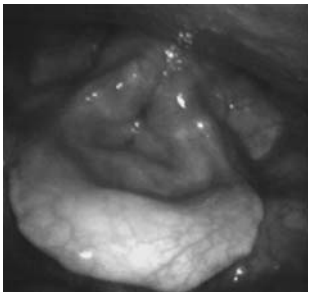


Airway Closure for Breath Holding

Tight Breath Hold:

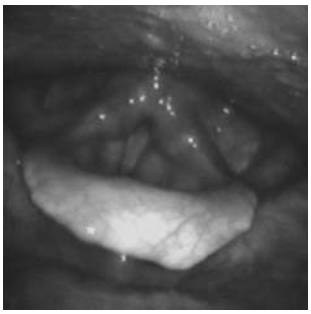
› TVCs & FVCs contact

› Arytenoids may tilt forward to touch the base of epiglottis

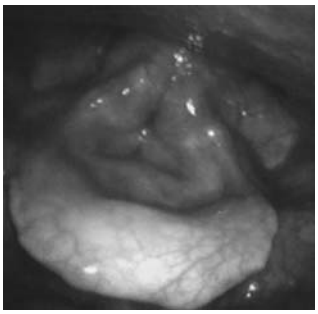


Airway Closure for Breath Holding

LIGHT BREATH HOLD



TIGHT BREATH HOLD



Airway Closure for Swallowing: Overlapping order of events

1. Central apnea & inhibition of PCA (VC abductor) – VCs may move closer together
2. Arytenoids medialize – tilt forward to cover the glottis/ vocal folds
3. Epiglottis retroflexes as hyoid & larynx elevate
   - At white-out, TVC usually still open
4. TVC adductors contract – complete VC closure
   - About 0.63 seconds after arytenoids begin medialization
   - Larynx at mid-point of elevation or higher

Airway Closure for Swallowing: Overlapping order of events

› What structural movement is most critical to protect the airway?

- THE VOCAL FOLDS?
- THE EPIGLOTTIS?
- THE ARYTENOIDS?

What About Airway Closure for Breath Hold… Followed by a Swallow? (VanDaele study)

VF & arytenoids contact (VC adduction) for breath hold, then….

2 patterns:

1. If LIGHT breath hold, closure was often temporary: TVCs reopened and swallow followed as a separate motor response.

BUT

2. If TIGHT breath hold, TVCs often maintained contact through the swallow.

VIDEO 4:

Airway closure to swallow Iowa study - stop after SSGS

Normal Airway Closure:

› Regular swallow and SSGS Swallow (Iowa Study)

Swallowing Requires an Intact **Sensori**-Motor System

› To detect the presence of a bolus to be swallowed
  – Sensory signals from mouth (sensory receptors in mouth)
  – travel to brainstem – if strong signal, *will trigger a swallow*

› Sensory signals also travel to higher brain centers (cortex)
  → Higher centers send excitatory signals to the brainstem *to help execute a faster, stronger swallow*

› . Sensory receptors are also in pharynx

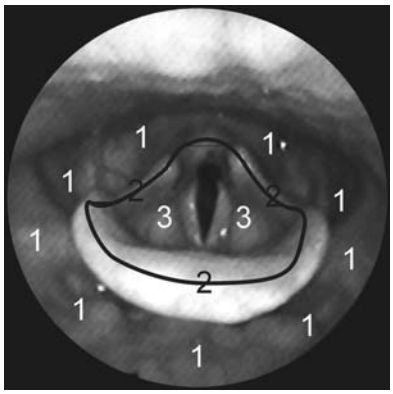
› **Most acute density of sensory receptors on laryngeal rim: a bolus crossing the rim should trigger a …?**

A bolus crossing the rim should trigger a …

› **swallow**. (if not already triggered)

› What triggers a cough??

Laryngeal Rim



Response/Awareness of Sensory Information in the HP can be appreciated with FEES

› Patient response to bolus leakage, to residue, to penetration, to aspiration

› Response to scope

› OR – can be tested directly (discussed in Protocols)

Normal swallowing requires normal structural movement

AND

Functionally normal structures

In other words, ANATOMY is equally important!

Anatomy is needed to…

› Direct the bolus SAFELY (keep it out of the airway)
› Direct the bolus EFFECTIVELY (move it into the esophagus)

Anatomy determines the path of the bolus

Which Tool Sees What Structures?

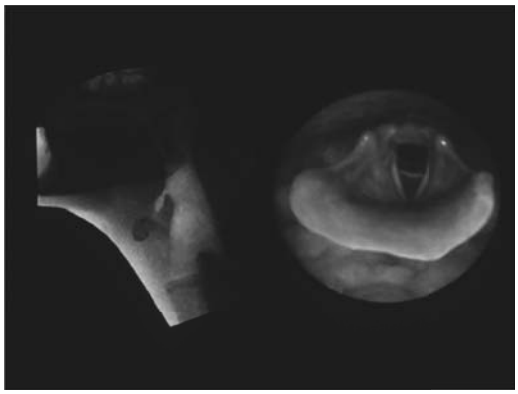
FLUOROSCOPY

› Sagittal (lateral) and coronal (frontal) views
› Broader region of interest
› Outlines of structures, submucosal structures (osteophytes, diverticulum)

ENDOSCOPY

› Axial view (from above)
› Larynx in detail
› Mucosal surface, configuration, relationship of different structures within the hypopharynx

MBS vs. FEES Views



Indications for FEES vs. MBS

FEES vs. Fluoroscopy

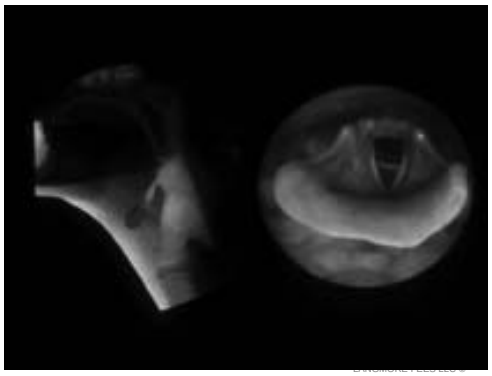
Objectives of the Exams are Similar

› Figure out what is wrong
› Figure out what can help

But there are many differences!

FEES vs. Fluoroscopy

› The view is different: What do you want to visualize?



Findings Unique to Fluoroscopy

- The bolus during the height of the swallow
- The oral phase in detail
- Completeness of tongue retraction
- UES opening
- Hyoid & laryngeal elevation
- Extent of aspiration
- Anatomical abnormalities beneath the surface (osteophytes, esophageal narrowing, Zenker's diverticula, etc)

Findings Unique to Endoscopy

- Secretions (location, amount, viscosity, patient reaction)
- Direct assessment of sensation
- Surface anatomy / mucosal abnormalities (edema, erythema)
- Configuration of the hypopharynx and effect on bolus flow
- Airway protection directly
- VC mobility
- Arytenoid movement
- Path of bolus
- Location of bolus residue within the HP

My Indications for fluoroscopy

› The problem is unclear: may be oral, pharyngeal, or esophageal..

› Patient complains of symptoms that suggest esophageal dysphagia
- Food sticks at SSN
- Food sticks and if patient waits, it passes
- Globus

› Suspect UES stricture

› Cannot visualize airway with endoscopy (eg., edema)

My Indications for FEES – Logistic Reasons

› Transportation to Radiology risky – medically fragile patient (ICU patient)

› Fluoroscopy not available; transportation to a hospital problematic, costly, stressful

› Positioning problematic for fluoroscopy – contractures, neck halo, obese

› Concern about radiation – esp. for children!

Indications for FEES – Clinical Reasons

› You want to view the vocal folds; airway closure

› You want to observe cranial nerve function (VP, larynx, pharynx: CNs 9,10,11,12

› You want a conservative exam –to avoid aspiration if possible
- severe pulmonary status
- severe swallow status?

› You want to see if patients can handle secretions

› You want to do a therapeutic exam

Contraindications for FEES

› Recent nasal trauma, obstruction, surgery, etc

› Bleeding disorder with high risk of uncontrolled epistaxis (but see Warnecke's study, 2009)

› Agitated; delirious; combative

Two Important Principles

1. Either examination will be satisfactory for many patients.
2. When the first examination does not answer all the clinical questions, do the second examination!

FEES is well suited for some medical problems, settings.

ICU Patients

Use FEES

› Logistic reasons – "safer environment"

› Post intubation – visualize larynx

› Tracheostomized – visualize airway, secretions, glottic closure for cough

Skoretz -Systematic Review (2010)*

› Looked at Incidence of post-intubation dysphagia in ICU

› Variable incidence across studies

› Clinical exams did not detect dysphagia or aspiration as often as FEES

*Skoretz SA, Flowers HL, Martino R. The incidence of dysphagia following endotracheal intubation: a systematic review. *Chest.* 2010;137(3):665-673

Post-surgical Patients

ENT – structures resected

Thoracic – heart, esophagus

– Is the larynx affected?

Clinical cues:

› Altered voice quality

› Wet voice quality

› Weak cough

› Neurosurgery – base of skull, brain

– (cranial nerve involvement?)

General Medical & Geriatric Patients

› FEES superior for a conservative exam; good for…

– Advanced COPD

– Active Pneumonia

– Other Pulmonary Conditions

› What to look for?

– Respiratory rate

– Effortful breathing

– Ability to hold breath and sustain TVC adduction

– Fatigue over the meal

Acute Stroke Patients

Severe brainstem stroke – not sure if swallow present?

- If MBS, may aspirate barium immediately
- FEES can reveal a lot about a patient's status from secretions, part 1 tasks, or just ice chips

FEES is safe in acute stroke patients

Warnecke 2009* performed FEES within 1 day of stroke with no complications. Patients were all on anticoagulants

*Warnecke T, Teismann I, Oelenberg S, et al. The safety of fiberoptic endoscopic evaluation of swallowing in acute stroke patients. Stroke; a journal of cerebral circulation. 2009;40(2):482-486.

Acute Rehab/SNF/LTC Patients

› Diagnosis is already known – rehabilitation is the focus:
- They are perfect rehabilitation candidates

FEES is an excellent tool for guiding treatment

biofeedback

time to try multiple strategies

involvement of patient and family

(more in Treatment lecture)