Dysphagia in Infants and Children

Dysphagia is not a disease. Rather it is a symptom of a disease that may be affecting any part of the swallowing tract from the mouth to the stomach.”

Donner, 1986

Why should specialty services be interested in feeding/swallowing disorders?

- Clinicians
  - Evaluation / management

Why Should Pediatric Specialists be Interested in Feeding/Swallowing Disorders?

- Clinicians
  - Evaluation / management
  - Future implications
    - Malas et al. (2015): Early feeding swallowing disorders may serve as potential markers of language impairment

Why Should Pediatric Specialists be Interested in Feeding/Swallowing Disorders?

- Clinicians
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- Researchers
  - Outcomes
  - Biomarkers
**Knowns: Primary Goals for Feeding & Swallowing**
- Maximize child’s potential for growth & development
- Optimize overall health status
- Promote positive interactions between the child and caregiver(s)

**Anatomic Division of Swallowing: Phases**
- Bolus preparation & formation
- Bolus transit
- Bolus flow and propulsion
- Breathing & airway protection
- Bolus direction

**Swallowing Dysfunction is a Symptom**
- Dysphagia
  - Oral preparatory
  - Oral
  - Pharyngeal
  - Esophageal

**Impairments in Sucking**
- Swallowing Dysfunction is a Symptom
  - Conditions or Disease Process(es)
  - Dysphagia
    - Oral preparatory
    - Oral
    - Pharyngeal
    - Esophageal
**Pharyngeal Phase:** Airway Protection Problems

- Penetration / aspiration
- Impaired airway clearance (e.g., silent aspiration)
- Poor pharyngeal clearance
  - ± aspiration
  - Prolonged mealtimes

**Penetration (Supraglottic)**

Entry of secretions or ingesta into the larynx ABOVE the true vocal folds

**Aspiration (Sub-glottic)**

Entry of secretions or ingesta into the larynx BELOW the true vocal folds

**Swallowing Dysfunction is a Symptom**

- Oral preparatory
- Oral
- Pharyngeal
- Esophageal

**Esophageal Phase:** Transit & Airway Protection Problems

- Incomplete or inefficient bolus passage
- Stricture or web
- Disruption of peristalsis
- Retrograde aspiration
"Dysphagia is not a disease. Rather it is a symptom of a disease that may be affecting any part of the swallowing tract from the mouth to the stomach." Donner, 1986

---

**Potential Causes**
- Anatomic anomalies
- Neurologic conditions
- Complex medical conditions
- Lack of or delayed introduction of feeding

**Potential Consequences**
- Aspiration / Resp. Problems
- Nutrition Compromise
- Altered family/social interactions

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**Factors that Determine / Modify the Impact of the Swallowing Dysfunction**

**Host Characteristics**
- Diagnostic condition(s)
- Co-morbidities
- Severity of dysphagia

**Age / Timing of Exposure**
- Growth and development
- Susceptibility to injury

**Environmental / Social Factors**
- Feeding techniques
- Health care access and management
- Exposure to environmental stressors

Adapted: Lefton-Greif + McGrath-Morrow, 2007

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**Severity of the Dysphagia**
- Phases
- Ability to compensate
- Prognosis dependent upon underlying diagnostic condition

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**3 - 17 year olds**

**Medical Complexity (Median age: 14 months)**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Median Age</th>
<th>Age Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastroesophageal reflux disease</td>
<td>123 (75)</td>
<td>3 - 17 years</td>
</tr>
<tr>
<td>Developmental delay</td>
<td>113 (69)</td>
<td>3 - 17 years</td>
</tr>
<tr>
<td>Pulmonary disorders</td>
<td>84 (51)</td>
<td>3 - 17 years</td>
</tr>
<tr>
<td>Neurological/neuromuscular disorders</td>
<td>50 (30)</td>
<td>3 - 17 years</td>
</tr>
<tr>
<td>Anatomical/structural disorders</td>
<td>41 (25)</td>
<td>3 - 17 years</td>
</tr>
<tr>
<td>Known genetic/syndromic disorders</td>
<td>38 (23)</td>
<td>3 - 17 years</td>
</tr>
<tr>
<td>Environmental exposures/social concerns</td>
<td>17 (10)</td>
<td>3 - 17 years</td>
</tr>
<tr>
<td>Cardiac disorders</td>
<td>16 (10)</td>
<td>3 - 17 years</td>
</tr>
<tr>
<td>Allergy/immune/systemic processes</td>
<td>12 (7)</td>
<td>3 - 17 years</td>
</tr>
</tbody>
</table>

Bhattacharyya, 2015

---

**Potential Feeding / Swallowing Problems**
- Oral preparatory
- Oral
- Pharyngeal
- Esophageal

---

Lefton-Greif et al., 2014
Potential Diagnostic Influences
- Acute
- Chronic
- Static
- Progressive

Anatomic
- Neurologic
- Medical Status
- Developmental + Oral-Motor Status
- External to Child

Impact of Potential Diagnostic Factors: Dysphagic Characteristics

<table>
<thead>
<tr>
<th>Potential Influences</th>
<th>Prognosis</th>
<th>Chronic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurologic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developmental + Oral-Motor Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External to Child</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Rogers, 1996

Factors Determining Impact of Anatomic / Structural Conditions on Swallowing
- Location, location, location
- Extent of impairment
- Presence of other anomalies or co-morbidities
  - e.g., isolated palatal cleft vs. cleft associated with a craniofacial syndrome

Brown, Lefton-Greif, Ishman, 2010

Four Anatomic / Structural Sites of Associated with Dysphagia

A. Nose and nasopharynx
B. Oral cavity and oral pharynx
C. Hypopharynx and larynx
D. Trachea and esophagus

Anatomic Division of Swallowing

- Bolus preparation & formation
- Bolus transit
- Bolus flow and propulsion
- Breathing & airway protection
- Bolus direction

Nose and Nasopharynx

IMPACT: May impair coordinated breathing, bolus preparation and propulsion
- Airway caliber and degree of airway obstruction
- Unilateral vs. bilateral obstruction
- Age and compensatory ability

FINDINGS: Craniofacial dysmorphisms, mouth breathing, hyponasal speech, stertor, snoring, OSA, VPI, nasal discharge

ACQUIRED: Mass, adenoid, scar

Brown et al., 2010
**Oral Cavity and Oral Pharynx**

**IMPACT:** Prolonged feeding, failure to thrive, texture preference, drooling, incoordination with respiration,

**FINDINGS:**
- Craniofacial, cleft lip/palate & velopharyngeal insufficiency
- Mouth breathing, large tonsils, snoring, obstructive sleep apnea
- Articulation, dysarthria
- Dentition - malocclusion
- Tongue - ankyloglossia

Brown, et al., 2010

---

**Larynx, Esophagus, Trachea:** Any condition causing respiratory distress may cause dysphagia

**TRIAD OF CONCERNS**
- Breathing – stridor (obstruction)
- Feeding – dysphagia
- Voice – dysphonia/cry

**FINDINGS:** Stridor, globus, snoring, stertor, cough, recurrent infection, chronic pulmonary disease, hoarse/breathy voice, failure to thrive, texture preferences

Brown, et al., 2010

---

**Larynx, Esophagus, Trachea:** Any condition causing respiratory distress may cause dysphagia

**FINDINGS:** Stridor, globus, snoring, stertor, cough, recurrent infection, chronic pulmonary disease, hoarse/breathy voice, failure to thrive, texture preferences

**PATHOLOGY:**
- TVF paralysis & lesions
- Vascular cushion
- Laryngeal cleft/TEF
- Tracheomalacia
- Vascular ring
- Mediastinal mass
- Stricture/GERD/EoE

Brown, et al., 2010

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**Stridor: Type, Location, Pathology**

**INSPIRATORY:** at or above glottis
- Laryngomalacia, pharyngeal hypotonia (OSA), lesions, vocal fold paralysis

**BIPHASIC:** glottic or subglottic
- Vocal fold paralysis, subglottic stenosis
- Inspiratory sounds may be louder than expiratory

**EXPIRATORY:** tracheal obstruction
- Tracheomalacia, vascular ring, foreign body

Brown, et al., 2010

---

**Swallowing Dysfunction is a Symptom**

**Conditions/Populations at Increased Risk for Dysphagia**

- Anatomic or structural anomalies
  - Congenital
  - Acquired
- Neurologic conditions
  - Acute
  - Chronic (static/progressive)
- Preterm + low birth weights
- Cardiopulmonary disease
- Medically fragile
- Misc.
Impact of Potential Diagnostic Factors: Dysphagic Characteristics

<table>
<thead>
<tr>
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<tr>
<td>Medical Status</td>
<td></td>
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</tr>
<tr>
<td>Developmental + Oral-Motor Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental to Child</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Rogers, 1996

Factors that Determine / Modify the Impact of the Swallowing Dysfunction

- Host Characteristics
  - Diagnostic condition(s)
  - Co-morbidities
  - Severity of dysphagia
- Age/Timing of Exposure
  - Growth and development
  - Susceptibility to injury
- Environmental/Social Factors
  - Feeding techniques
  - Health care access and management
  - Exposure to environmental stressors

Host Characteristics: Impact of Neurologic Defects

- Location (aka Site of lesion)
- Nature of lesion (acute, progressive, chronic)
- When the lesion occurred
- Stressors
- Potential phase of swallowing impairment
- Prognosis / anticipated changes over time

Host Characteristics(Co-Morbidities): Modify the Impact Dysphagia

- Respiratory stability
- Nutrition status
- Immune system
- Medications
- Endurance
- Ability to compensate for:
  - "Unexpected" changes (e.g., illness)
  - Needed changes (e.g., surgery)

Other Host Characteristics

- Neurodevelopmental status
- Current and anticipated levels
- State (infants)
- Oral motor skills & Feeding Experience
  - Weak, primitive, abnormal
  - Nutritive and non-nutritive experiences
Other Host Characteristics

- Temperament / Behavior
- Feeding refusal, aversion, appetite
- Attention span, language, cognitive function
- Sensori-motor integration – strengths + problems

Host Conditions (e.g., Co-Morbidities): May Modify Impact of the Dysphagia

- May influence child’s ability to tolerate the respiratory or nutritional consequences of the dysphagia
- Some children may not be able to tolerate:
  - Even “normal” aspiration because of their fragile cardiopulmonary status or
  - Fluctuations in oral intake because of nutrition status

Host Conditions: May Modify Impact of the Dysphagia

- Anatomic/neurologic changes
  - Prognostic or treatment related changes
- Other systems
  - E.g., child who needs to stay healthy and grow for needed surgery

When Feeding/Swallowing Problem is Suspected…

Clinic or Bedside Evaluation

What is a Clinic or Bedside Swallowing Evaluation?

- History
- Physical examination
- Observation of mealtime

Goals of Clinical Evaluation

CAN’T versus WON’T
Different Perspectives
- In context of underlying diagnosis
- Consider strengths as well as weaknesses

Why do a bedside/clinic evaluation?
To determine or identify:
- Establish a baseline of function
- Interactions between child and feeder
- Responses to non-nutritive stimulation
- Behaviors during oral feeding – in some children
- Determine if a feeding/swallowing problem is present
- Define potential phase or phases of impairment

Why do a bedside/clinic evaluation?
To determine or identify:
- Explore and evaluate the utility of therapeutic maneuvers
- Determine need for, timing of and type of instrumental evaluation

History
- Chief complaint
- History of present illness
- Past medical history
- Developmental history
- Feeding history
- Family and social history

History: Sample Areas to Probe
- Define concerns
- Temporal manifestation of problem(s)
- Health issues
- Neurodevelopmental issues
- Diet / feeding routine

Previous Feeding-Related Experiences
- Oral experiences
  - Non-nutritive
  - Nutritive
- Feeding route
- Oral hygiene
- Appetite
- Textures, food preferences
- Previous therapies
Sensitive Period (Knudsen, 2004)

- **Def:** broad term that applies whenever the effects of the experience on the brain are usually strong during a limited period of time
- **Importance:** a time in development when certain capacities are readily shaped or altered by experience

Critical Period (Knudsen, 2004)

- **Def:** a special class of sensitive periods that results in irreversible changes in brain function
- **Importance:** adverse effects of atypical experience throughout a critical period cannot be remediated by restoring typical experiences later in life

Critical or Sensitive Periods: Impact of Swallowing Dysfunction...

- On growth and development
  - In-utero
  - Lungs
  - Nutrition
  - Post-natal
  - Brain
  - Lungs

Critical or Sensitive Post-natal Periods: How much swallowing is necessary for:

- Swallowing
- Oral secretions
- Liquids and food
- Desire to feed
- Sucking
- Chewing

Critical or Sensitive Periods

- Early flavor experiences
- Breast vs. bottle feeding (Sullivan & Birch, 1994)
- Chewing (Illingworth & Lister, 1964)

Feeding History: Recommended Feedings for a Normal Infant

<table>
<thead>
<tr>
<th>Age</th>
<th># Of Bottles</th>
<th>Vol./ Per Bottle (ml)</th>
<th>Age</th>
<th>Volume (oz)</th>
<th># Of Feeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth - 1 week</td>
<td>6 - 10</td>
<td>30 - 90</td>
<td>0 - 1 mo</td>
<td>2 - 5</td>
<td>6+</td>
</tr>
<tr>
<td>1 wk - 1 month</td>
<td>7 - 8</td>
<td>60 - 120</td>
<td>1 - 2 months</td>
<td>5 - 7</td>
<td>4 - 6</td>
</tr>
<tr>
<td>1 - 3 months</td>
<td>5 - 7</td>
<td>120 - 180</td>
<td>3 mo</td>
<td>7 - 8</td>
<td>4 - 6</td>
</tr>
<tr>
<td>3 - 6 months</td>
<td>4 - 5</td>
<td>180 - 210</td>
<td>5 mo</td>
<td>5 - 10</td>
<td>4 - 6</td>
</tr>
<tr>
<td>6 - 9 months</td>
<td>3 - 4</td>
<td>210 - 240</td>
<td>7 mo</td>
<td>7 - 11+</td>
<td>4 - 6</td>
</tr>
<tr>
<td>10 - 12 months</td>
<td>3</td>
<td>270 - 240</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Oski, et al. 1984: p.38
Table 2: Developmental & Oral-Motor Skills Associated with Feeding Progression: Birth to 24 Months

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>Progression of Liquids &amp; Foods</th>
<th>Oral-Motor Skills</th>
<th>Developmental Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 2</td>
<td>Liquid</td>
<td>Stroke out tongue</td>
<td>Head control</td>
</tr>
<tr>
<td>4 - 6</td>
<td>Puree</td>
<td>Cup drinking</td>
<td>Head control</td>
</tr>
<tr>
<td>6 - 9</td>
<td>Puree, Soft chewables</td>
<td>Cup drinking,</td>
<td>Head control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vomiting</td>
<td>Head control</td>
</tr>
<tr>
<td>9 - 12</td>
<td>Cup feeding, Lump meats</td>
<td>Cup drinking</td>
<td>Head control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vomiting</td>
<td>Head control</td>
</tr>
<tr>
<td>12 - 18</td>
<td>Cup feeding, Lump meats</td>
<td>Vomiting</td>
<td>Head control</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Head control</td>
</tr>
<tr>
<td>18 - 24</td>
<td>More chewable foods</td>
<td>Vomiting</td>
<td>Head control</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Head control</td>
</tr>
<tr>
<td>24+</td>
<td>Tougher solids</td>
<td>Vomiting</td>
<td>Head control</td>
</tr>
</tbody>
</table>

Neurodevelopmental History

- Developmental abilities
- Functional skills
- Positional needs / tone
- Cognitive abilities
- Speech / language skills
- Previous therapy efforts/ outcomes

Feeding Hx: "Typical" Food Progression

<table>
<thead>
<tr>
<th>Typical Food Progression</th>
<th>Age (mos)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puree fruits/vegetables/cereal</td>
<td>3 - 6</td>
</tr>
<tr>
<td>Ground or junior foods</td>
<td>5 - 6</td>
</tr>
<tr>
<td>Mashed table foods (small pieces)</td>
<td>8 - 10</td>
</tr>
<tr>
<td>Soft finger foods</td>
<td></td>
</tr>
<tr>
<td>Hard finger foods (dry cereal, crackers, cookies)</td>
<td></td>
</tr>
<tr>
<td>Coarsely chopped table foods (pieces 1/4&quot; or larger)</td>
<td></td>
</tr>
<tr>
<td>Easily chewed foods (e.g. hot dogs, luncheon meats, chicken fish)</td>
<td>12</td>
</tr>
<tr>
<td>Difficult meats</td>
<td></td>
</tr>
</tbody>
</table>

Wolf & Glass 1992

History: Medications

- Central nervous system
  - Depressed level of arousal
  - Suppression of brainstem regulation
  - Movement disorders
- GI tract
- Respiratory
- Seizure

History: Specific Medications

- Baclofen to treat spasticity
- Fatigue
- Drooling
- Benzodiazepines (e.g., diazepam [valium]) to relax muscles or treat seizures
  - Sedative side effects
  - May influence brainstem centers that control swallowing

Family & Social History, and Environmental Exposures

- Family members
- Health history (e.g., asthma, allergies, GER)
- Others with feeding/swallowing problems
- Feeding routine/environment
- Caregiver/child interactions, day care
- Exposures: tobacco, pets
Feeding/Swallowing History: Three Key Areas to Probe

1. Is it safe?
2. Is it adequate / enough?
3. Is it enjoyable vs. stressful?

Is it Safe?
- Patterns
  - Onset?
  - Liquids/solids?
  - Feeding utensil?
  - When, time of day?
  - Frequency?
  - Changes in severity or frequency?
- Are there unexplained respiratory problems in the setting of difficult mealtimes?

Is it Enough?
- How long does it take to feed the child?
  - Longer than 30 minutes (NICU: 20-30 mins)
- Is the child gaining weight?
  - NICU has guidelines
  - Infants/young children, no weight gain for 2 - 3 months is comparable to weight loss in adults
  - Older children, when the child’s clothing size was changed last (not only for length)

Is it Enjoyable, vs. Stressful?
- Are meal times stressful for child and/or caregivers?
  - Neurologic based skill & safety issues?
  - Behavior and / or sensory-motor issues?

What Happens During a Clinic/Bedside Feeding/Swallowing Evaluation?
- History
- Physical examination
- Observation of feeding
  - Interactions between child and feeder
  - Responses to non-nutritive stimulation
  - Behaviors during oral feeding – in some children

Physical Examination
- General appearance, tone
- Examination of oral-peripheral structures and functions
  - Feeding / swallowing
  - Speech / language
Physical Examination

- Non-nutritive actions (pre-requisites for feeding / swallowing)
  - Gloved finger
  - Pacifier

Non-nutritive Sucking (NNS)

- Sucking in absence of oral intake
- Rapid sucking = 2 sucks / sec.
- Alternating bursts of activity & periods of rest

### Infant Oral Reflexes Present at Term

<table>
<thead>
<tr>
<th>Reflex</th>
<th>Stimulus</th>
<th>Cranial Nerves</th>
<th>Age of Disappearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gag</td>
<td>Touch posterior tongue or pharynx</td>
<td>IX, X</td>
<td>Persists</td>
</tr>
<tr>
<td>Phasic bite</td>
<td>Pressure on gums</td>
<td>V</td>
<td>9 - 12 months</td>
</tr>
<tr>
<td>Tongue protrusion</td>
<td>Touch tongue or lips</td>
<td>XII</td>
<td>4 - 6 months</td>
</tr>
<tr>
<td>Transverse</td>
<td></td>
<td></td>
<td>6 - 9 months</td>
</tr>
<tr>
<td>Rooting</td>
<td>Touch corner of mouth</td>
<td>V, VII, XI, XII</td>
<td>3 - 6 months</td>
</tr>
<tr>
<td>Sucking</td>
<td>Nipple in mouth or stroking top of tongue</td>
<td>V, VII, IX, XII</td>
<td>9 - 12 months</td>
</tr>
<tr>
<td>Swallowing</td>
<td>Bolus of food in pharynx</td>
<td>V, VII, IX, XII</td>
<td>Persists</td>
</tr>
</tbody>
</table>

Arvedson et al 1993, p.41

What Happens During a Clinic/Bedside Feeding/Swallowing Evaluation?

- History
- Physical examination
- Observation of feeding
  - Interactions between child and feeder
  - Responses to non-nutritive stimulation
  - Behaviors during oral feeding – in some children

Observation of a Meal

- Ideal but **NOT** obligatory component of clinical evaluation
- Caregiver-patient interactions
- Introduction of therapeutic techniques

Oral Feeding / Nutritive Sucking (NS)

- Occurs = 1 suck / sec.
- Alternating bursts of activity & periods of rest *
- Compression & suction components of NS *
- NS (suck/swallow) and breathing coordination *

*Post-natal maturation
Nutritive Suck / Swallow / Respiratory Patterns*

<table>
<thead>
<tr>
<th>Pattern</th>
<th># Sucks/Burst</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immature</td>
<td>3 - 5</td>
<td>Suck = Pause Duration</td>
</tr>
<tr>
<td>Transition</td>
<td>5 - 10</td>
<td>Disorganized Poor suck/sw/br coordination</td>
</tr>
<tr>
<td>Mature</td>
<td>10 - 30</td>
<td>Continuous sucks Brief pauses</td>
</tr>
</tbody>
</table>

*Bu'Lock et al 1990 & Palmer 1993

Nutritive Suck / Swallow / Respiratory Patterns*

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disorganized</td>
<td>Lack of rhythm</td>
</tr>
<tr>
<td>Dysfunctional</td>
<td>Interruption of feeding w/ abnormal movts of tongue &amp; jaw</td>
</tr>
</tbody>
</table>

*Bu'Lock et al 1990 & Palmer 1993

Smooth Puree

- 4 to 6 months
- cooked potato
- avocado
- cooked pumpkin
- mashed (smooth) foods

Lumpy Puree

- 6 to 8 months
- cooked potato
- grilled meat or chicken
- cooked zucchini
- cutlery or mashed (lumpy) foods

Finger Foods

- 9 to 12 months - finger foods
- finger sandwiches
- cooked meat, chicken or fish
- banana
- cooked broccoli
- cooked pumpkin

Major Components of a Clinical Feeding/Swallowing Evaluation

- History
- Physical examination
- Observations of feeding
- Determination of the utility of an instrumental swallowing assessment