Children with cleft palate are at risk for speech-language deficits

- Anatomical variation causes a coupling of the oral and nasal cavities
  - Influences production of high pressure oral phonemes.
  - Influences articulatory placement of specific phonemes.

- Anatomical variation contributes to risk of conductive hearing loss
  - Degrades the auditory signal that interferes with the input the child receives from caregivers as well as from his/her own speech attempts.
  - Both are important for phonological development.
  - Otitis media contributes to delays in vocal development, as well as the size and variety of the consonant inventory size.

True canonical babbling ratio = # of True canonical syllables / Total number of syllables

Variables in the Degrades the auditory signal that interferes with the input the child

More nasal, glides, and glottal sounds, with few stop consonants.

True consonant inventory at 21 months of age was the best indicator of children have adequate

Produce few words beginning with oral stops.

Canonical Tend to avoid the alveolar ridge as a place of articulation.

Differences / Deficits persist after surgical repair, and are unrelated to cleft type or use of a palatal obturator.

Speech Characteristics: After the Palate Repair

- Increased canonical babbling ratio.
  - Canonical syllable is comprised of a supraglottic consonant + a fully resonant vowel (e.g. “mama”).
  - Canonical babbling ratio = Number of canonical syllables / Total number of syllables

- Increased consonant inventory.
  - Continued to exhibit a decrease in overall size of consonant inventory.
  - On average, children with cleft palate produced 3x fewer consonants than their non-cleft peers.

- Increased production of alveolar, palatal, and velar phonemes.

- Decreased glottal features.

- Produced more stop consonants, specifically /b/.

Speech Characteristics: In Infancy - Prior to Palate Repair

- Delay in the onset of canonical babbling.
- Decreased consonant inventory size.
- Variations in the complexity of babbling:
  - Decreased true consonant babbling ratios.
  - Lower mean babbling levels.
  - Variations in the diversity of sounds:
    - More nasal, glides, and glottal sounds, with few stop consonants.
    - Preference for the extremes of the vocal tract (i.e. /m/ is Glottal).
    - Tend to avoid the alveolar ridge as a place of articulation.

Impact of Early Speech Characteristics on Later Speech-Language Development

- Children with cleft lip and palate show lexical selectivity based on their phonological characteristics.
- More words beginning with vowels, nasals, and glides.
  - Produce few words beginning with oral stops.

- Children with cleft lip and palate with higher mean babbling ratios at 12 months of age have better speech-language skills at 3 years of age.
  - Larger consonant inventories and higher rates of stop consonant production.

- True stop production, both immediately before and after palatal surgery, is positively correlated with speech production measures at 21 months of age.
  - True consonant inventory at 21 months of age is the best indicator of children have adequate velopharyngeal function and normal speech-language skills at 39 months of age.
Additional Speech Characteristics: Toddler Years

- At 30 months of age, children with cleft lip and palate decreased their use of glottal stops, but presented with less fricatives than non-cleft peers. (Scherer, Williams, Proctor-Williams, 2008)
- At 39 months of age, children with cleft palate had an average 2 fewer consonants in their phonetic inventory and were producing shorter utterances with a decreased MLU compared to non-cleft peers. (Hardin-Jones & Chapman, 2018)
- Children with cleft palate age 2 years of age exhibited a higher frequency of:
  - Compensatory articulation errors (i.e. Cleft speech characteristics): such as Glottal stops, Velar fricatives, Mid-dorsum palatal stops.
  - Specific phonological patterns: Nasal assimilation and backing. (Chapman, 1992)

Significance of Nasalization

The presence of nasal substitutions following palatal surgery is not always an early sign of Velopharyngeal Insufficiency:
- In a recent study of 13-39 month old children, Hardin-Jones & Chapman (2018) discovered:
  - 35% of toddlers in non-cleft peer group produced nasal substitutions on one or more of their early words.
  - 75% of toddlers with cleft lip and palate produced nasal substitutions on one of their early words.
  - Only 38% of the toddlers with cleft palate who produced nasal substitutions were later diagnosed as having significant hypernasality and suspected Velopharyngeal Insufficiency.
- In a recent unpublished work, Zajac (2018) reported:
  - Gradual emergence of stop consonants in a sample of toddlers following cleft repair by 20 months of age.
  - Parent report of stop consonants is discrepant and may be overestimated.

Goals of Intervention

1) Increase consonant inventory.
2) Increase consonant inventory and vocabulary simultaneously.
   - "The relationship between sound inventory and vocabulary growth in early development is intertwined; Vocabulary expansion provides opportunities to practice new sounds and increased sound inventories permit greater diversity of vocabulary" (Hardin-Jones, Chapman, & Scherer, 2006, p. 32)
3) Increase awareness of airflow.

Refrain from the Use of Oral-Motor Exercises

Such as blowing, sucking, whistling, and swallowing.

These non-speech activities do not strengthen the velopharyngeal mechanism.

Children with cleft palate typically do not have oral-motor problems or muscle weakness. They have speech sound production problems that are best addressed using conventional articulation/phonological strategies or vocabulary approaches.

Enhanced Milieu Teaching with a Phonological Emphasis

Enhanced Milieu Teaching

- Components
  - Response Interaction
    - Back and forth interaction (i.e., "conversational") which promotes turn taking.
    - Components of responsiveness:
      - Following child’s lead/interests (within play or conversation)
      - Responding to child’s communicative attempts (i.e., child’s verbal and non-verbal attempts)
      - Responding to child’s communication via comments or questions
      - Matching (i.e., imitation) and expanding on the "conversation"

(Scherer & Kaiser, 2010, p. 439)
**Enhanced Milieu Teaching**

- Components
  - Focused Stimulation
    - Repetition, Repetition, Repetition
    - Repeat via direct models, recasts, and within expanded phrases containing target word
      - Single words
      - 2. Word Combinations
      - True Consonants/Phonemes

(Scherer & Kaiser, 2010)

- Four Milieu Prompting Procedures
  - Model
    - Establish joint attention.
    - Provide a direct verbal model.
    - If no imitation, tell child “say ___.”

(Scherer & Kaiser, 2010)

- Four Milieu Prompting Procedures
  - Mand-Model
    - Verbal Prompts
      - Questions (What do you want?)
      - Choice (Do you want ___ or ___?)
      - Request or Mand (Tell me what you want).

(Scherer & Kaiser, 2010)

- Four Milieu Prompting Procedures
  - Time Delay
    - Pause time after direct models (i.e., natural opportunities to imitate)

- Incidental Teaching
  - Teaching in a natural context secondary to environmental arrangements

(Scherer & Kaiser, 2010)

**Intervention: < 3 years**

- Receptive and Expressive Language Delays
- Developmental Delays/Disorders
  - Improved receptive language, expressive language, and larger percent consonants correct (Kaiser et al., 2017)
  - Support for parent-implemented approach (Scherer, D'Antonio, & McGahey, 2008)
Enhanced Milieu Teaching + Phonological Emphasis

- Principles of EMT + PE
  - Goals
    - Focus on expressive language while monitoring speech production
    - Integrating Both
    - Speech production Only

- Cleft palate +/- Cleft Lip
- Principles of EMT + PE
  - Consider both speech intelligibility/production goals and language use
  - Focused stimulation of pressure consonants (high pressure stops and fricatives), reducing cleft compensatory articulation errors, correct productions of syllable shapes, increasing phonemic repertoire, increasing true consonant inventory, etc.
  - Increasing vocabulary (single word productions), word combinations, grammatical forms, etc.

Enhanced Milieu Teaching + Phonological Emphasis

- Focused Stimulation Flow Sheet (Scherer et al. 2008)
- Establish Joint Attention

<table>
<thead>
<tr>
<th>Correct Response</th>
<th>Incorrect Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child &quot;Key&quot;</td>
<td>Child &quot;PhS&quot;</td>
</tr>
</tbody>
</table>

- Corrective Model
- Clinician "Key"

- Incorrect Response
- Child "PhS + /j"

- Correct Response
- Clinician "Key"

- Present Object/Toy
- PhS = Pharyngeal Stop

In Practice...

Case Study – George

- 14 Month Old Boy
- Full-term male; No complications during pregnancy or birth.

- Bilateral Cleft Lip and Palate.
- Lip repair: 3 Months of age.
- Palate repair: 12 Months of age.

- Recurrent Otitis Media.
- Audiologic assessment with verification of normal hearing at 12 Months of age.

In Practice...


- Findings:
  - Age-appropriate receptive language; Mild expressive language delay.
  - Limited consonant repertoire: /m, n/; "Hard glottal vowels; Frequent Glottal Stop Productions; No true consonants besides nasals.

- Recommendation: Speech Therapy 1x/week for 6-months

- Intervention Approach: Focus on caregiver education of Environmental Arrangement, Responsive Interaction, & Focused Stimulation Strategies (Enhanced Milieu + PE). Goals to target expressive language and speech.

- Results of Intervention (18 months): Increased speech sound inventory with emergence of high-pressure oral phonemes /p, b, g/, decreased glottal productions, and expressive language scores within normal limits.

Enhanced Milieu Teaching + Phonological Emphasis

- Cleft palate +/- Cleft Lip
- Principles of EMT + PE
  - Consider only speech intelligibility/production goals
  - Focused stimulation of pressure consonants (high pressure stops and fricatives), reducing cleft compensatory articulation errors, correct productions of syllable shapes, increasing phonemic repertoire, increasing true consonant inventory, etc.
Speech-Language Intervention for Toddlers with Cleft Palate: Palatoplasty to Preschool ISHA 2020

Enhanced Milieu Teaching + Phonological Emphasis

- Focused Stimulation Flow Sheet (Scherer et al. 2008)
- Establish Joint Attention
- Model
- Correct Response
- Clinician "shh"
- Incorrect Response
- Child "NF"
- Corrective Model
- Clinician "shh"
- Present Object/Toy
- Corrective Feedback
- Child "shhh" and "go to sleep"
- Praise
- Expand

NF = Nasal Fricative

In Practice...

Case Study – Lily

- 20 Month Old Girl
- Full-term; No complications during pregnancy or birth.

- Cleft of the Soft Palate Only
  - Palate repair: 11 Months of age
  - Bilateral Myringotomy & PE Tube Placement at 11 months. Audiologic assessment with verification of normal hearing at 12 Months of age.

- Initial Evaluation: 13 months Old
  - Expressive and Receptive Language scores WNL
  - True Consonant Inventory: /m, n, b, d, g/
  - No Compensatory Errors. No speech therapy recommended at that time. Follow Up.

In Practice...


- Re-Assess at 20 months old
  - Language Scores: WNL
  - True Consonants: /m, n, b, t, d, g/
  - Nasal Fricative Substitutions by /s, z/ and SH.

- Recommendation: Speech Therapy 1x/week for 6-months

- Intervention Approach: Focus on caregiver education of Environmental Arrangement, Responsive Interaction, & Focused Stimulation Strategies (Enhanced Milieu + PE). Goals to target speech.

- Results of Intervention (at 32 months old): Goals met for /s, z/. Emerging for SH.

Complexity Approach

- Founded in theories of cognition & linguistics
- Strong evidence base for efficacy & efficiency
- 3-6 year olds
  - Missing 5-7 sounds from their phonemic inventories
  - Single subject studies*

**Complexity Approach**

- "Complexity: the trigger of language learning." (Gierut, 2007, p. 6)
**Goals of Phonological Intervention**

1) Bring about the greatest amount of change in the child's sound system
2) Bring about this change as efficiently as possible

_How do we structure intervention to facilitate language learning?_

Consider:
- Developmental norms
- Implicational relationships between sounds
- Child’s knowledge
- Method of treatment

**Developmental Norms**

- Late-acquired targets = Sounds that are typically acquired one year or later beyond the child's current age
- Late 8: /s, z, ʃ, ð, l, r/
- Targeting later-developing sounds results in improvement in children's productions of unrelated, untreated sounds

**Implicational Relationships**

*If X, then Y, but not vice-versa.*

- X is more complex than Y
- X is the "marked" feature, and Y is "unmarked."

**Child’s Knowledge**

_Characteristics of child’s phonological knowledge_

- Accuracy
- Stimulability

**Complex Treatment Targets**

*Choose a sound that is...*

- Acquired later
- Marked
- Produced in error
- Non-stimulable

_Following these guidelines leads to system-wide change!_
Speech-Language Intervention for Toddlers with Cleft Palate: Palatoplasty to Preschool ISHA 2020

Method of treatment
Target sounds in minimal pairs with maximal contrasts

Sound Pairs should...
• Differ by manner, place, & voicing
• Differ by major class
  - consonant vs. glide or obstruent vs. sonorant

<table>
<thead>
<tr>
<th>Child's sound system</th>
<th>Potential targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>/m, n, w/</td>
<td>/l, r/</td>
</tr>
<tr>
<td>/y, s/</td>
<td>/th, t/</td>
</tr>
<tr>
<td>/j, w, h, k, g/</td>
<td>/r, f/</td>
</tr>
</tbody>
</table>

Loca Choca
Loca

Complexity Approach

Complex Treatment Targets ➔ Greater Phonological Change

In Practice...
Case Study – Lucy

• Full-term; asymptomatic atrial–septal defect
• Bilateral Cleft Lip and Palate, Complete
  - Lip Repair: 7 months
  - Palate Repair: 12 months
• Fistula – junction of hard and soft palate
• Dual Language Learner of Spanish and English

In Practice...
Initial Speech–Resonance Evaluation: 2 years; 0 months of age

• Findings:
  - Age-appropriate receptive language; Mild expressive language delay
  - Limited consonant repertoire: /m, n, h, w, “y/; No stop consonants

• Recommendation:
  - Continue Early Intervention services
  - Bilingual Speech Therapy 1x/week for 3-6 months

• Initial Intervention Approach: Enhanced Milieu Teaching with a Phonological Emphasis
  - Bilingual Speech Therapy initiated at this facility at 2 years; 3 months

In Practice...
Shift in Intervention after 5 months – 2 years; 8 months of age

• Targeting /l/ in words and nonsense words was initiated; this sound is expected at 4 years of age in Spanish

• Initially Lucy was not stimulable for this sound

• Results: Lucy produced /l/ in 60% of trials after 2 months; she now is stimulable for /p/
In Practice...

Shift in Intervention after 7 months – 2 years; 10 months of age

- Targeting "CH" & /l/ in words and nonsense words was initiated; these sounds are expected at 3 years of age in Spanish
- Initially Lucy was not stimulable for either sound
- Results: Lucy continues to substitute /h/ for "CH," but she is stimulable for /l/ & /s/

In Practice...

Next steps for Lucy

A child's speech sound production guides assessment of velopharyngeal function.

Now that Lucy is attempting high-pressure consonants, she can participate in instrumental assessment of velopharyngeal function (i.e., Nasopharyngoscopy) to further guide surgical intervention for her fistula and/or potential velopharyngeal insufficiency.

Cycles Phonological Remediation Approach

Theoretical Underpinnings

- Phonological acquisition is a gradual process.
- Children with normal hearing typically acquire the adult sound system primarily by listening.
- Children associate kinesthetic and auditory sensations as they acquire new phonological patterns, enabling later self-monitoring.
- Phonetic environment can facilitate (or inhibit) correct sound production.
- Children tend to generalize new speech production skills to other targets.
- An optimal match facilitates a child's learning.
- Children are actively involved in their phonological acquisition.
- Enhancing met phonological skills facilitates speech improvement as well as development of early literacy skills.

Key Features

1) Pattern-Focused selection of intervention targets.
   - Errors are considered linguistically based and are attacked at the rule level, rather than at the phonetic level.
   - Stimulable phonemes are utilized to target a deficit phonological pattern: Single phonemes serve as a means to an end, rather than a specific goal.
2) Cyclical targeting of problematic patterns.
   - Deficit phonological patterns are presented in a cyclical fashion, in order to expedite intelligibility gains.
   - Cycle duration depends upon the number of deficit patterns a child needs to target, as well as the number of deficit sounds in each pattern that are stimulable.
3) Use of auditory input in combination with production-practice activities during treatment sessions.

Typical Session Structure

1) Review production-practice words from previous session.
2) Read new list of target words, under slight amplification.
3) Provide motivational, experiential-play production practice activities.
4) Incorporate metaphorological awareness activity (e.g. Rhyming).
5) Probe for stimulability to determine next session’s target.
6) Repeat listening activity from the beginning of the session, under slight amplification.
7) Instruct caregivers in home program: Caregivers read listening list and facilitate child naming of production-practice word list for 2 minutes per day.


Adaptations for Toddlers

- May be unwilling to participate in production-practice activities.
- Engage in focused auditory input/stimulation for phonological patterns.
  - Environmental arrangement with parallel play activities.
  - Home program of listening words (e.g. Book reading).
- Children increase participate in production-practice activities by next cycle.

(Hodson, 2011; Hodson, 2015)

Evidence with Children with Cleft Palate

A phonetic based disorder may initially occur as a consequence of the cleft. Over time, these errors become incorporated into the child’s developing rule system, producing a phonologic disorder. (Chapman, 1993)

- Within a single case study: Elimination of cleft type speech characteristics and normalized substitution patterns in 13-months as compared to 2.5 years of intervention using a single phoneme approach. (Hodson, Chin, Redmond, & Simpson, 1983)

- As compared to a traditional articulation approach, the total time of speech intervention necessary for correcting children compensatory articulation disorder associated with cleft palate was critically reduced when a phonological approach was used. (Hodson, Chin, Redmond, & Simpson, 1983)

In Practice…

Case Study – Patrick

- Full-term male; No complications during pregnancy or birth.
- Left, Unilateral Cleft Lip and Palate.
  - Lip repair: 3 Months of age.
  - Palate repair: 10 Months of age.
- Recurrent Otitis Media in first 2 years of life.
  - Failed newborn hearing screening.
  - Audiologic assessment with verification of normal hearing at 24 Months of age.

In Practice…

Initial Speech-Language Evaluation: 10 Months of age.

- Findings:
  - Age-appropriate receptive language; Mild expressive language delay.
  - Limited consonant repertoire: /m, n, h, w, “y/;
    - Hard glottal vowels; No stop consonants.
- Recommendation: Speech Therapy 1x/month for 3 months
- Intervention Approach: Focus on caregiver education of Environmental Arrangement, Responsive Interaction, & Focused Stimulation Strategies
- Results of Intervention: Increased speech sound inventory with emergence of high-pressure oral phonemes /b, d/, and decreased glottal productions.

In Practice…


- Findings:
  - Age-appropriate receptive and expressive language.
  - Speech sound repertoire: /m, n, h, w, “y/;
    - Nasal substitution: m / b
  - Emergence of pharyngeal stop production: /k/
- Recommendation: Speech Therapy 1x/week for 6-12 months.
- Intervention Approach: Enhanced Milieu Teaching with a Phonological Emphasis.
- Results of Intervention:
  - Increased speech sound inventory, with incorporation of all true stop consonants into repertoire.
  - Emergence of cleft type speech characteristics: Nasal Fricatives
Findings:

- Voiceless fricatives and affricates:
  - Stopping of all voiced fricatives and affricates
  - Nasal substitutions (Nasal Fricative) for all voiceless fricative and affricates
  - Glottal Stop for medial /p/

- Stopping of Voiced Fricatives:
  - Requires VPI until VPI is achieved
  - Nasal substitutions (Nasal Fricative) for all voiceless fricative and affricates

- Production practice of /f, s/: Targeting speech sound production in the phonemes /f, s/.
- Production practice of /v, z/: Targeting speech sound production in the phonemes /v, z/.

- Speech sound repertoire: /m, n, h, w/, /y, x, s/.

In Practice...

Re-Assessment:
- 2 Years, 6 Months of age.

- Findings:
  - Age-appropriate receptive and expressive language.
  - Speech sound repertoire: /p, b, m, n, h, w, y, v, z, s, f, sh, th, k, g, ch/.
  - Glottal Stop for medial /p/.
  - Stopping of all voiced fricatives and affricates.
  - Nasal substitutions (Nasal Fricatives) for all voiceless fricative and affricates.

- Recommendations: Speech Therapy 1/week for 6-12 months.

In Practice...

Cycles Approach Design

Cycle 1 Targets:
- Nasal substitutions (Nasal Fricative) for all voiceless fricative and affricates
- Cyclic production practice of /f, s/.
- Stopping of Voiced Fricatives
  - Listening & Paralinguistic Play with non-stimulable phonemes /s, h/.

Cycle 2 & 3 Targets:
- Nasal substitutions (Nasal Fricative) for all voiceless fricative and affricates.
- Production practice of /v, z/.
- Stopping of Voiced Fricatives
  - Production practice of stimulable phonemes /s, h/ in word final position

Results of Intervention: Discharged within 6-months with remediation of all cleft type speech characteristics, and emerging use of later developing phonemes.

References


References


