ULTRASOUND BIOFEEDBACK FOR SPEECH SOUND DISORDERS IN CHILDREN

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Clinical Strategies for Pediatric Speech Sound Errors

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LEARNING OBJECTIVES

1. Explain the benefits and effectiveness of ultrasound visual biofeedback (U-VBF) for treating children's speech sound disorders
2. Identify and compare cueing strategies in U-VBF for correcting /r/, /l/, and /s/ errors.
3. Demonstrate techniques to help children engage in U-VBF therapy effectively.

SPEECH TECHNOLOGY

Electromagnetic Articulograph (EMA)

Uses sensors to track speech movements; difficult to use with children, lacks intervention software, and is very expensive.

Electropalatography (EPG)

Tongue–palate contact: Custom palate required (costly, time-consuming). Provides limited data on: tongue movement before contact, non-contact areas, and velar plosives with open vowels.

X-Rays

Radiation

Ultrasound

Non-invasive, easy and convenient to use, could be quickly sanitized and used across multiple clients, excellent visual biofeedback tool.

WHY USE ULTRASOUND VISUAL BIOFEEDBACK?

- Make invisible articulators visible
- Immediate, actionable feedback
- Enhances proprioceptive awareness
- Engages visual learners, older children, and teens
- Validates progress for parents and clinicians
- Visualization of lateral bracing, lingual differentiation, dorsal lowering, and midline/central groove

SET-UP

High frequency sounds (outside of the upper limits of the human hearing).

Ultrasound imaging frequency for tongue articulation (2-5 MHz)

- 2MHz: Grainy but good for consonants & high vowels (adults/older children)
- 5MHz: Resolution fades with depth - younger children

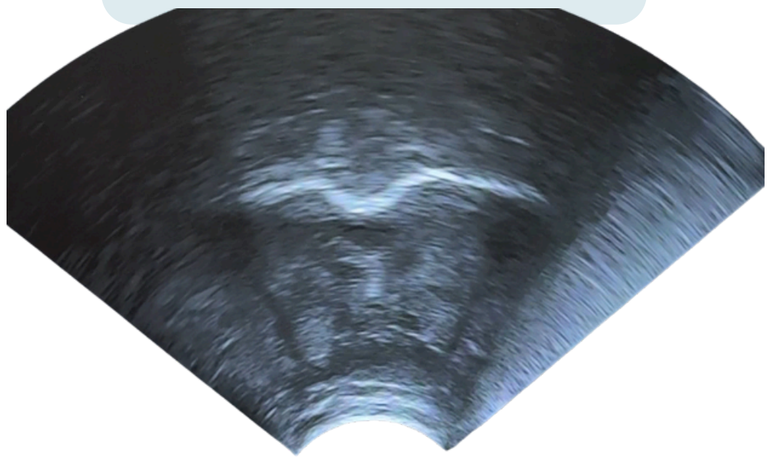
Our Clinical Set-Up

Device: Micro research bundle from Articulate Instruments (UK)
Speech capture Software: Articulate Assistant Advanced (AAA)
Probe: Microconvex probe

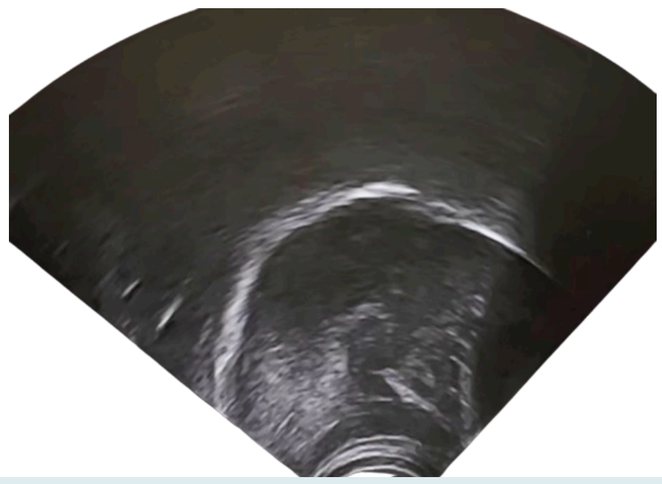
How does it work?

- B-Mode: Radial pulses
- Brightness = tissue–air boundary strength
- Bone absorbs sound → dark shadows
- Angled tissues = weak reflections
- Adjust field/depth of view as needed

CORONAL VIEW POSITIONING



MIDSAGITTAL VIEW POSITIONING



CLIENT CONSIDERATIONS

Age School aged (5+ years old)

Population Articulatory and Motor Speech Disorders (MSD)

Target Lingual differentiation & coordination issues
Non-stimulable speech sounds

Therapy Readiness Resilience, high motivation, adequate cognitive abilities

Others Toleration of gel, fat deposits and loose skin under chin

CUE EXAMPLES

- Lateral bracing: “make a bird” (coronal view)
- Dorsal lowering: “move this part down”
- Lingual differentiation: “let’s move the tip of the tongue and now the back of your tongue”
- Central groove: “bend the middle” (coronal view)

RESEARCH

Population	Research
Cleft-lip/Cleft-Palate	Cleland et al., 2025; Cairney et al., 2025; Hashemi Hosseinabad & Xing, 2024
Hearing difficulties / cochlear implant	Foss, 1990; Bacsfalvi, 2007; Gibson & Lee, 2021
Persistent speech sound disorders	Shawker & Sonies, 1985; Cleland et al., 2015; Spencer et al., 2023; Cleland, & Scobbie, 2021; Preston et al., 2021; Preston et al., 2019; Cleland et al., 2015
Childhood apraxia of speech (CAS)	Preston et al., 2013; Preston et al., 2016; Preston et al., 2017
Velar fronting in Preschool age children	Heng et al., 2016
Speech Sound Disorders & others (Dysarthria, Downs syndrome)	Hitchcock et al., 2019; Sugden et al., 2019 (Systematic Review)

LIMITATIONS

- Jaw, lip and soft-palate movements cannot be visualized.
- Voicing (unless ultrasound over larynx)
- Difficult to see anterior / tongue tip especially when elevated
- Extremely rapid movements: multisyllabic, phrasal and conversational speech (sounds, syllable and monosyllabic word levels ideal)

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