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### BACKGROUND

Problems with producing clear, intelligible speech can occur in cleft lip and palate (CLP), even after successful surgery to repair the palate.

**Current methods of assessment:**
- Perception-based phonetic transcription
- Electropalatography (EPG)
- Micro high-speed cineloop system at 100fps over a 150 degree field of view

**Advantages of Ultrasound Tongue Imaging (UTI) over EPG:**
- cheaper
- images from near the tongue tip to the root
- pharyngeal articulations, common in CLP, are visible
- does not require individualised equipment
- can continue to be used as child grows or following surgery

### Therapy

Ultrasound can be used as a visual biofeedback tool (U-VBF), to provide children with real-time feedback on their articulations. This can lead to quick remediation of deeply engrained articulatory patterns demonstrated by a growing evidence base (~30 small studies, e.g.2, 3, 4). However, only one small study has focussed on the CLP population, with just two children with sub-mucous cleft.5

### AIMS

**STUDY 1: Assessment**

To develop an ultrasound-based diagnostic assessment for identifying imperceptible speech errors in children with cleft palate which will be a viable tool for clinical practice and circumvent the practical problems associated with EPG.

**STUDY 2: Intervention**

To evaluate the effectiveness of U-VBF in remediating speech disorders in CLP.

### PARTICIPANTS

<table>
<thead>
<tr>
<th>Study 1 Assessment</th>
<th>Design</th>
<th>Analyses</th>
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<tbody>
<tr>
<td>~48 children Aged 3-15 Non-syndromic or syndromic CLP</td>
<td>Head set stabilises probe under chin</td>
<td>Perceptual analysis - phonetic transcriptions</td>
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<tr>
<td></td>
<td>Micro high-speed cineloop system at 100fps over a 150 degree field of view</td>
<td>Visual analysis of ultrasound – documented live</td>
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<td>Data collected: spontaneous counting</td>
<td>Quantitative analysis of ultrasound using Articulate Assistant Advanced software6 and a range of measures:</td>
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<tr>
<td></td>
<td>all consonants in /aCa/</td>
<td>- Dorsum Excursion Index</td>
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<td></td>
<td>minimal sets contrasting common substitutions</td>
<td>- LOC&lt;sub&gt;a&lt;/sub&gt;</td>
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<td></td>
<td>Sentences from the CleftNet Protocol</td>
<td>- Modified Curvature Index</td>
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<td>- Nearest Neighbour Distances</td>
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<table>
<thead>
<tr>
<th>Study 2 Intervention</th>
<th>Design</th>
<th>Analyses</th>
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<tbody>
<tr>
<td>~8 children from study 1 with lingual speech errors</td>
<td>Single subject multiple baseline across participants</td>
<td>Probes, wordlists and DEAP transcribed by SLT blind to the intervention time point and scored for % segment on target</td>
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<td>10x 45 minute weekly therapy sessions</td>
<td>Celeration lines and 2SD band methods to determine progress statistically within speakers</td>
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<td>Target specific untreated probes: 3 baseline, mid-therapy, post-therapy, 3 month post-therapy</td>
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### ERROR TYPES REVEALED BY ULTRASOUND: Examples form Children with Speech Sound Disorders.

- Increased contact
- No contact/undershoot
- Fronted placement
- Complete closure (Loss of groove - coronal)
- Retraction to velar or palatal placement
- Double articulations

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**References**