Ultrasound study of tongue movements in childhood apraxia of speech

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Childhood apraxia of speech (CAS) is a neurological speech disorder marked by the impairment of precision and consistency of speech movements and resulting in speech sound and prosody errors. There is, however, no known method of verifying the neurological disruption, no clear picture of the potentially disrupted underlying speech production processes, and no unique set of speech characteristics which would enable reliable diagnosis or differential diagnosis of the disorder. Most of the information available about speech characteristics of CAS comes from acoustic studies. However, due to the motor nature of the disorder it seems appropriate to employ articulatory investigation as well.

The main aim of this study was to use both acoustic and articulatory (ultrasound tongue imaging) methods to investigate the impairment of timing and tongue movements in CAS by comparing the speech of speakers with CAS to typically speaking adults (TA) and typically developing children (TDC).

In total, 33 speakers participated in this study: 3 teenagers (14 – 18 years) with a persistent form of CAS, 10 TA (20-30 years) and 10 TDC (6-9 years). Each speaker made five repetitions of six monosyllabic English words differing in syllable onset structure (“pay”, “say”, “lay”, “play”, “slay”, “splay” ). Acoustic and ultrasound signals were recorded at the same time using the Articulate Assistant Advanced system.

Three parameters were evaluated: duration of the target words, the amount of tongue movements over the words (based on the nearest neighbour distances between the points of consecutive tongue contours) and the overall rate of movement. Additionally, ultrasound data enabled visual comparison of tongue movements in each of the six words by observing movement patterns of the entire tongue contour and of the highest point on every contour of the target words.

Preliminary results based on descriptive statistics show that the three parameters do not distinguish speakers with CAS from TA or TDC groups but they do differentiate the control groups from each other (e.g., shorter duration, greater tongue movements, and a higher rate of movement for TA when compared to TDC). However, inspection of tongue movement patterns revealed that speakers with CAS seem to move their tongues less in the vertical and horizontal direction (in the midsagittal plane) than the control groups. The measure of the amount of tongue movement is not enough to reveal the differences and thus additional analysis of movement patterns will be performed to explore these observations further.