Compensatory Strategies in Individuals with Moebius Syndrome: A Case Study

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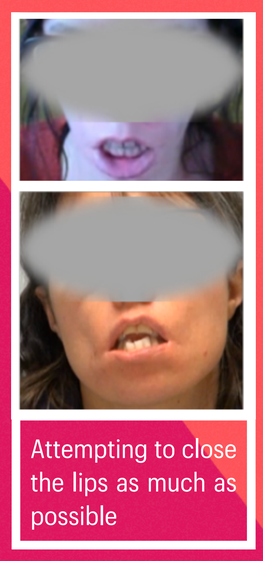
Background

- Rare congenital neuromuscular disorder (0.00002 to 0.002% of the world's population)
  - Absence or underdevelopment of 6th/7th cranial nerves, controlling horizontal eye movements and facial muscles (Verzijl et al. 2005)
  - Key (articulatory) features include lip paralysis and incomplete lip closure
  - Frequent misarticulations related to impaired labial function (Kahane 1979, Helmick 1980, Murdoch et al. 1997, Sjögreen et al. 2001, del Carmen Pamplona et al. 2022).
  - Around 20% appear to succeed in developing compensatory articulatory movements (Sjögreen et al. 2022)



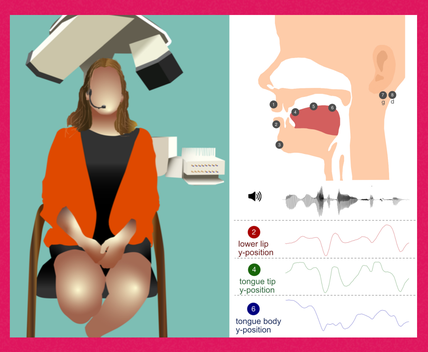
Attempting to close the lips as much as possible

Aim

- Fill gap by providing first (acoustic and) articulatory analysis of speech motor control mechanisms in two individuals with Moebius Syndrome, with intact speech intelligibility
- Describe compensatory articulatory strategies to inform fundamental issues in articulatory phonetics, specifically speech motor control

Method

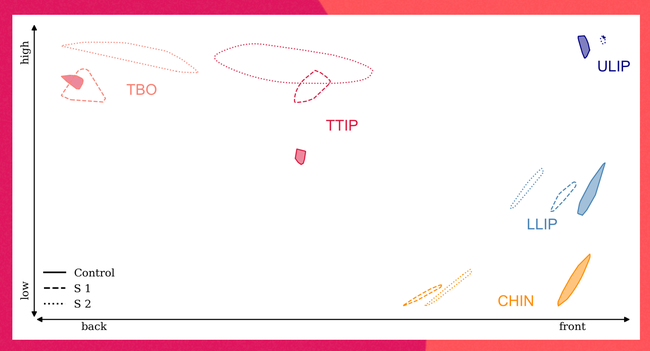
- Acoustic and articulatory data (EMA, AG 501)
  - Two female individuals with Moebius syndrome (S1=41 years; S2=43 years)
  - One control speaker (C=28 years)
  - Sensors (plus reference sensor)
    - Upper and lower lips
    - Tongue tip
    - Tongue body
    - Chin



- DDK tasks (production of syllable /pa/ on one breath cycle as fast and as precise as possible)
- Measures (over ten /pa/ repetitions): (1) convex hull area in mm² (range/extent of a sensor movement in horizontal and vertical dimension), (2) volume hull curve in mm³ (horizontal, vertical & lateral) in (A) /papapapa/ vs. (B) /tatatata/

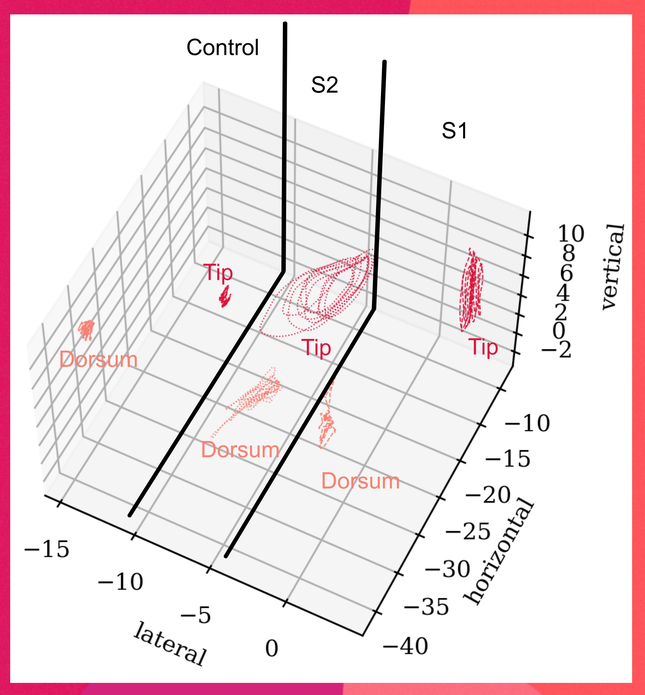
Results

(1) Convex hull in mm²



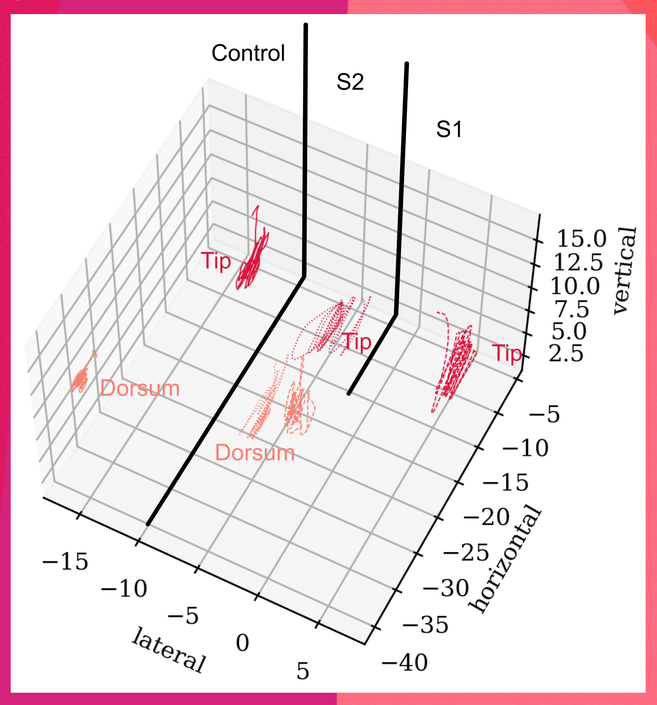
- Reduced range in lips & jaw (e.g., LLIP: S1=3.98mm²; S2=4.12mm² vs. C=7.4mm²)
- Tongue tip & body range much greater (e.g., TIP: S1=12.46mm²; S2=74.23mm² vs. C=1.97mm²)
- Tip much higher (towards palate)

(2a) Volume in mm³ -/papapapa/



- Volume (3D, lateral, vertical & horizontal) reflects the massive tip movements and also tongue body during labial DDK (TIP: S1=4.79mm3, S2=55.20mm3, C=0.5mm3, TBO: S1=7.64mm³, S2=21.70, vs. C=1.23mm³)
- For LLIP almost no movement in labial DDK (LLIP, S1=1.27mm³, S2=2.02mm³ vs. C=8.27mm³, ULIP: S1=0.01mm³, S2=0.12mm³ vs. C=3.10mm³)

(2b) Volume in mm³ - /tatatata/



- Volume in "intended" alveolar DDK reflect different patterns than for labial DKK (TIP: S1=42.72mm³, S2=22.21mm³, vs. C=14.85mm³, TBO: S1=17.78mm³, S2=9.15 vs. C=5.18mm³)
- OBS! for LLIP: S1=1.70mm³, S2=0.67mm³ vs. C=1.51mm³, ULIP: S1=0.01mm³, S2=0.02mm³ vs. C=0.88mm³)

Conclusion & Outlook

- No closure for labial stops, but some lower lip movement
- Excessive tongue movements in all dimensions indicating compensatory strategies
- DDK is an artificial movement paradigm (Ziegler et al. 2002), however, first insights in how speech motor control is affected
- Reveal of intriguing (different) strategies adopted by these individuals to navigate speech limitations in producing labials
- Next: Acoustic analyses; "natural" sentence productions

References

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