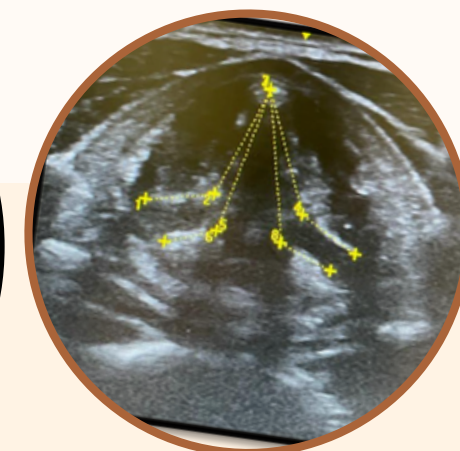


An investigation of paediatric vocal functions with laryngeal ultrasound imaging



Introduction & objective

Voice disorders among children are common and they compromise their quality of life. To achieve early detection and intervention, a handy and reliable instrument for screening voice disorders would be of great utility. Emerging research evidence is supporting the use of laryngeal ultrasonography in paediatric voice assessment and screening. This research aims to extend our current understanding on paediatric vocal fold structures and functions by collecting ultrasound image data from Cantonese-speaking children with and without voice disorders.

Methods

Participant

7 children (all males) aged between 4-9 were recruited. Their vocal health status was determined by parental-report and auditory-perceptual evaluation of examiners. 5 of them are vocally healthy and 2 have voice problems.

Data collection

Ultrasound imaging was performed using the ultrasound system GE LOGiQ e8 with a linear probe of 4-15MHz by two examiners. During the examination, the participant was put in a supine position and had the neck stretched, with a pillow placed underneath. Three sets of ultrasound videos were obtained including:

- vocal fold view at quiet breathing
- subglottic view at quiet breathing
- vocal fold view at max phonation of /i/

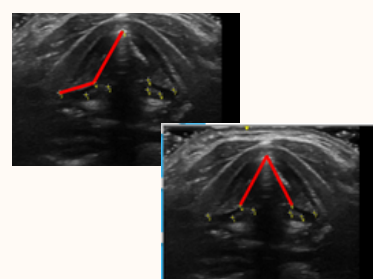


Data Analysis

Each examiner separately worked on the set of ultrasound videos they obtained. They selected one static image that best capture the target area from each set of their videos. Structural landmarks (e.g., arytenoid cartilages and true vocal folds) were then identified and the measurement points were plotted manually using the software Fiji.

The parameters measured are:

- Vocal-fold arytenoid angle
- Maximum glottic angle
- Vocal fold length
- Subglottic Airway Diameter



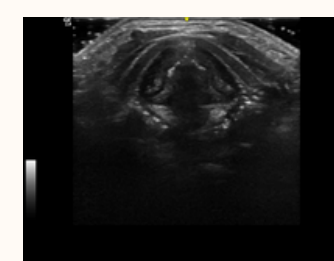
Inter-and intra-rater reliability were also computed.

Results

- Vocal fold arytenoid angle
 - abduction **larger than** adduction on both left and right vocal folds
- Maximum glottic angle
 - usually within the range of **35-55** degrees. The values are comparable across age groups.

- Vocal fold length
 - in general, older participants (age 6 or above) have longer right and left vocal fold lengths than younger ones
- Subglottic airway diameter
 - difference across age was not observed

- Visualisation of possible presence of vocal pathologies



The left picture shows suspect of bilateral vocal nodules (highlighted with red circle) of a participant with vocal hoarseness. The right picture shows the vocal folds of an age-matched vocally healthy participant.

- High operator dependency

Inter-rater reliability

- Pearson correlation coefficient ranges from -0.012. to 0.449 across different parameters, indicating a small to moderate correlation. Yet, none of the correlations could reach statistical significance.
- Independent sample t-test indicated that the mean difference between raters was not statistically significant.

Intra-rater reliability

- stronger correlation compared to inter-rater reliability
- left VAA at abduction, left VAA at adduction, MGA, subglottic airway diameter had a strong correlation of 0.721, 0.61, 0.98 and 0.924 respectively (the latter two are statistically significant).
- Related sample t-test indicated non-significant mean difference for all parameters (except for left VAA at abduction).

Conclusion

The current study is a preliminary step to understand paediatric vocal structures and functions using laryngeal ultrasound imaging. The inter-rater and intra-rater reliability for the current study remains low as reflected by the non-statistically significant correlation for most parameters.

There are multiple directions for future study:

- Improvements on research design to enable more vigorous results (e.g., blinding, clearer task instructions)
- Establishment of normative data with more balanced ratio of female and male participants as well as inclusion of more children with various types of vocal pathologies
- Increasing inter-and intra-rater reliability of laryngeal ultrasonography
- Validation of laryngeal ultrasonography against flexible transnasal laryngoscopy

