Features of vocal fold vibration

Longitudinal phase difference

Vertical phase difference

Glottal area waveform

- Opening
- Closing
- Point of maximum opening
- Closed phase
- Open phase
- 1 cycle (T)
Aerodynamic-myoelastic theory of phonation

Glottal vibration results from interacting aerodynamic, muscular and elastic forces

3 things necessary and sufficient for phonation
1. Adduction (often termed medial compression)
2. Longitudinal tension (VF has an appropriate amount of tension along its length)
3. Aerodynamic pressures (pushing and pulling by air flow and pressure)

A model account of the theory

- a “two mass model” is the simplest model necessary to allows sustained vocal fold oscillation and account for the important of the vertical phase difference
Coronal view

2-mass model

Upper part of vocal fold
Mechanical coupling stiffness
Lower part of vocal fold
Coupling between mucosa & muscle
TA muscle
• VF adducted & tensed → myoelastic pressure ($P_{me}$)
• Glottis is closed
• Subglottal air pressure ($P_{sg}$) ↑
• $P_{sg} \approx 8-10$ cm H$_2$O, $P_{sg} > P_{me}$
• L and R M1 separate
• Transglottal airflow ($U_{tg}$) = 0

As M1 separates, M2 follows due to mechanical coupling stiffness $P_{sg} > P_{me}$

glottis begins to open $P_{sg} > P_{atm}$ therefore $U_{tg} > 0$
$U_{tg} \uparrow \uparrow$ since glottal aperture $<<$ tracheal circumference

$U_{tg} \uparrow P_{tg} \downarrow$ due to Bernoulli effect

Bernoulli’s law

$P + \frac{1}{2} \rho U^2 = K$

where
$P =$ air pressure
$\rho =$ air density
$U =$ air velocity
$U_{tg} \uparrow P_{tg} \downarrow$ due to Bernoulli effect

$P_{tg} < P_{me}$

M1 returns to midline

M2 follows M1 due to mechanical coupling stiffness

$U_{tg} = 0$

Pattern repeats 100-200 times a second