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Influence of vocal fold stiffness on phonation characteristics at onset in a body-cover vocal fold model

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The influence of the body and cover stiffnesses on phonation onset and the resulting vibration pattern was investigated in a body-cover continuum model of the vocal folds. An eigenvalue analysis was performed to obtained phonation onset characteristics. The analysis showed that, with increasing body-cover stiffness ratio, both the phonation threshold pressure and frequency (normalized by the Young's modulus and wave speed of the cover layer, respectively) first increased rapidly and then gradually approached a plateau. For a given glottal resting opening, a soft vocal fold body led to a larger prephonatory glottal opening, which had an negative effect on phonation onset pressure, and for certain vocal fold geometries, led to a local minimum in the phonation threshold pressure as a function of the body stiffness. Although the phonation threshold pressure was low for a vocal fold configuration with both a soft cover and a soft body, the vocal fold vibration at onset exhibited a significant whole-body vertical motion and a low sound production efficiency, and therefore it may not be desirable for voice production. For a large body-cover stiffness ratio, this vertical motion was suppressed and vibration was restricted to the cover layer and the medial surface, resulting in a more effective flow modulation and a better sound production efficiency.