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Major Benefits of Semi-Occluded Vocal Tract Exercises

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Much has been written about the application of semi-occluded vocal tract (SOVT) exercises, both for singing and speaking. Their efficacy is no longer challenged, but when practitioners are asked to explain what goes on inside the airway during these exercises, the answers are inconsistent and occasionally incorrect. There are several physical phenomena that happen simultaneously:

1. The upper portion of the vocal fold is spread apart, proportional to the steady pressure that is built up in the supraglottal vocal tract, behind the semi-occlusion.
2. The medial surfaces of the vocal folds can become parallel without pressing the vocal folds together if cricothyroid and thyroarytenoid muscle activities are balanced.
3. Phonation threshold pressure is lowered with parallel and slightly separated vocal fold surfaces.
4. Vocal fold vibrational amplitude and collision forces are reduced with slightly separated vocal folds, allowing lung pressure and fundamental frequency to be taken high in a pitch glide. The stretching of the vocal folds strengthens the vocal ligament for better control of, and access to, high pitches.
5. The first resonance frequency is lowered to around 200 Hz, which means that the lower-frequency harmonics can benefit from vocal tract acoustic inertance in a range from 200—1500 Hz. The approximately equal reinforcement of harmonics helps to avoid register instabilities and supports mixed registration.
6. The acoustic inertance of the vocal tract also lowers the phonation threshold pressure.

The beauty of the exercises is that most of these effects occur simultaneously without much voluntary adjustment. The system self-regulates. For example, higher lung pressure produces larger vibrational amplitude, but higher lung pressure also produces more vocal fold separation. The combined actions leave the contact stress regulated at a low value. As another example, with higher fundamental frequency, as in a pitch glide, vibrational amplitude is naturally reduced because the vocal folds (especially the ligament) are stiffer. More lung pressure (support) can then be added to increase the amplitude without creating more collision.

Whenever semi-occlusions are discussed in pedagogic and clinical circles, the questions arise regarding the diameter, the length, and the material of the tube or straw. In what I have described above, the diameter is the most critical component. A small diameter produces the greatest flow resistance, and hence the greatest oral pressure. A longer tube produces slightly more acoustic inertance, but the effect is secondary because a semi-occluded vocal tract is already inertive. The important harmonic frequencies (f_o, $2f_o$, and $3f_o$) are all higher than F_1 and mostly lower than F_2. This puts them into inertive territory. Finally, the material of the straw or tube (plastic versus glass) matters little. Both have much greater wall stiffness than vocal tract soft tissue and therefore do not yield much or absorb much energy at the walls. A plastic straw can be pinched to further regulate the resistance. Some practitioners use multiple parallel thin straws, beginning with three and gradually working toward one if variable resistance is needed to adapt to the "bottled-up" feeling.

The last question that generally arises pertains to the use of a glass of water to terminate the distal end of the tube or straw with a higher flow resistance (water versus air). Aside from the air bubbles that are created, the effect of which I have not studied in reference to laryngeal function, the higher resistance can be obtained equivalently by using a smaller diameter straw. The unsteadiness of the pressure associated with the air bubbles does propagate to the larynx, producing a low frequency modulation that may, or may not, have therapeutic value.

The silver swan, who living had no note,
When death approach'd, unlock'd her silent throat;
Leaning her breast against the reedy shore,
Thus sung her first and last, and sung no more.
Farewell, all joys; O Death, come close mine eyes;
More geese than swans now live, more fools than wise.

Orlando Gibbons