IMPACT STRESS IN WATER RESISTANCE VOICE THERAPY. A PHYSICAL MODELLING STUDY.

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Phonation through a tube in water is used in voice therapy and training. Depth of immersion of the tube in water regulates the airflow resistance the tube offers. A question has arisen whether deep immersion can cause vocal overloading. This study aims to shed light on this topic by applying a physical model of the human voice production. The model consists of vocal fold replica made of silicon and a plexiglass tube representing the vocal tract when a person articulates [u:]. This model was used in order to compare impact stress (IS) in three conditions: When the model phonates on [u:] (1) without a tube, (2) with a silicon Lax Vox tube (35 cm in length, 1 cm in inner diameter) 2 cm in water, and (3) with the tube 10 cm in water. Subglottic pressure (Psub) and airflow ranges were selected so that they correspond to those reported in normal human voice production. Psub, and oral pressure (Poral), transglottic pressure and peak-to-peak Poral measured with the model were compared to those reported from 20 humans phonating into Lax Vox tube (data from Tyrmi et al. J Voice, 2016). The results show that firstly, if we consider only the raw data, we see that for flow rates 0,20-0,25 l/sec the IS increases with the tube, compared with phonation on [u:] without a tube, and this increase is more for the tube 10 cm in water than for the tube 2 cm in water. These results are due to the structure of the model: Flow is the driving force and, thus, the model is required to compensate for the increase in supraglottal resistance. If we then see the results differently, in relation to phonation threshold, we see that actually, the IS is highest for vowel [u:] without tube and then lower with the tubes, lowest with the tube 2 cm in water. So, even though the model and humans cannot be directly compared, taking for instance the fact that the human vocal tract wall is yielding, the results seem to suggest that IS is not likely to increase harmfully with water resistance therapy. However, there may be other effects related to it, possibly causing symptoms of vocal muscle fatigue (e.g. increased activity in the adductors). These need to be studied further.