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Producing a singer's formant at high front vowels - some kinematical and anatomical aspects

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In a series of scientific workshops for classical singers, our laboratory of Functional Anatomy tried to elucidate some kinematical backgrounds of the so-called singer's formant, "a merge between at least two formants, possibly F3 and F4" (Sterling, 2006). Recent measurements in a baritone by Radolf et al. (2012) showed that "a cluster of two or three formants was formed in the range of F2-F4 between 1.4 and 3.4 kHz for the vowel [i:]". Millhouse and Clermont (2006) demonstrated a distinct difference between F1 and F2, and a close proximity of F3 and F4 especially for the (sung as well as spoken) vowel /i/ in "Heed". Therefore we reconstructed some functional-anatomical phenomena in pronouncing the word "Heed", by means of a crossed four-bar-linkage model simulating jaw motion in a sagittal plane (Van Zwieten et al., 2001). Bars represent respectively the skull-base, the intercrossing bundles of jaw-elevating muscles masseter and medial pterygoid, and the mandibular angle. During uttering the high front vowel in "Heed", the tongue's dorsum is lifted, so as to narrow the linguo-palatal port, while the velo-pharyngeal port simultaneously closes (Ladefoged, 1993; Soquet et al., 2002). Although Sundberg et al. (2007) presume individual preference in the amount of this velo-pharyngeal closing during the production of a singer's formant, we rather interpret this as a tautening of the palatine aponeurosis by bilateral activity of the tensor veli palatini muscle, neuromotorically associated with a slight elevation of the mandible by bilateral activity of the medial pterygoid muscle. Of all muscles of the soft palate namely, only *m. tensor veli palatini* shares its motor nerve with the nerve for the jaw-closing *m. pterygoideus medialis*. (The other velar muscles receive motor branches from the vagus nerve.) Once taut, the palatal velum will allow its freely moving uvular muscle to more or less "close the velo-pharyngeal port". The nasal tract plus its sinuses then enhance resonance, thus favoring the production of a singer's formant once more. *Acknowledgements* : We would like to thank tenor Robert Luts, Professor of Singing, and bass Joris Grouwels, MSCE, for their help in preparing this survey.

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