

Biomechanics of sound production in high-pitched classical singing

June 18 2024



Credit: Pexels / Andrea Piacquadio

Opera singers have to use the extreme limits of their voice range. Many pedagogical and scientific sources suggest that the highest pitches reached in classical singing can only be produced with a so-called "whistle" voice register, in analogy to ultrasonic vocalizations of mice and rats.

An international research team, led by Christian T. Herbst of the University of Vienna and Matthias Echterdach from the Ludwig Maximilian University of Munich has now rejected this assumption.

In their study, the scientists showed that the high-frequency sounds of operatic sopranos are produced with the same principle as speech and most other forms of singing. The [study](#) was recently published in *Scientific Reports*.

For this study, nine professional operatic sopranos were asked to perform in a special laboratory situation: They phonated at highest pitches while the scientists made ultra-highspeed video recordings of the singers' throats and vocal folds with trans-nasal endoscopy.

Analysis of the video footage clearly showed that—depending on the sung [pitch](#)—the vocal folds in the throat vibrate and collide 1,000 to 1,600 times per second, commensurable with the produced sound's frequency.

This is in stark contrast to the alleged, but now refuted "whistle" mechanism, which would have required for the vocal folds to be immobile during voice production.

The study thus demonstrates that the "default" mechanism of voice production in humans and most mammals also applies to the upper pitch ranges of operatic singing. Simulations with a computer model suggest that the singers can only produce their highest frequencies with a greatly increased tension in the vocal folds, supported by high expiratory air pressures.

The study's senior author Herbst states, "This finally debunks a long-standing myth of voice pedagogy. It is remarkable that such extreme sounds can be produced with a rather common voice production

mechanism—this is only possible with outstanding muscular fine-control of the singers' vocal instrument."

Lead author Matthias Echternach adds, "It is truly amazing how some female singers can generate the extremely high tensions in their [vocal folds](#) that are required to produce these high-pitched sounds without incurring any vocal health issues. Why some singers succeed while others don't must remain open for now."

More information: Matthias Echternach et al, Biomechanics of sound production in high-pitched classical singing, *Scientific Reports* (2024). [DOI: 10.1038/s41598-024-62598-8](https://doi.org/10.1038/s41598-024-62598-8)

Provided by University of Vienna

Citation: Biomechanics of sound production in high-pitched classical singing (2024, June 18) retrieved 26 June 2024 from <https://phys.org/news/2024-06-biomechanics-production-high-pitched-classical.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.