WHEN FANTASY MEETS SCIENCE:
THE RECREATED VOICE OF ÖTZI THE "ICEMAN"

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ABSTRACT

Ötzi the Iceman's, the mummy found some years ago in the Similaun mountain, lived 5300 years ago, and obviously, we cannot say which language, which phonemes, or even which sounds could belong to him.

In this work, still in its initial stage, a possible reconstruction of an "approximation" of Ötzi the Iceman's voice, recreating the timbre and color of his Stone Age possible vowels will be described. This experiment, the first of its kind ever carried out on a mummy, was presented during a major congress to celebrate the 25th anniversary of the mummy's discovery in the Ötztal Alps in South Tyrol.

Obviously, we cannot say we have reconstructed Ötzi's original voice because we miss too many crucial information from the mummy. However, with two true measurements, the length of both the vocal tract and the vocal cords, we (could) have been able to recreate with a "high degree of fantasy", a hypothesized approximation of the mummy's vocal tract structure and consequently a hypothesized approximation of its voice.

Even knowing perfectly the Ötzi' respiratory capacity, his vocal chords dimensions and his vocal tract configuration measurements, still, there will be too many unknown factors that make impossible a true reconstruction of its voice.

With all these limitations in mind, with the help of a special software at SINTAC Biomedical Engineering in Padova, based on the CT scans of the mummy, we started to create a model of his original vocal tract and vocal chords, in order to try to have an idea of what could have been the old voice of Ötzi.

We had to face several challenges as we worked to reconstruct the 5,300-year-old mummy's vocal tract configuration. We had to deal with Ötzi's position, whose arm is covering his (neck), and, for our project, this is the worst position you can imagine. Moreover, the hyoid bone, or tongue-bone, was partially absorbed and dislocated. With

a special dedicated software, at SINTAC Biomedical Engineering in Padova, we were able to move Ötzi's arm from his position, to reposition his skull in the erect position, to reconstruct his vertebrae, from the first one (C1) closest to the skull to the first thoracic vertebra (T1), and to reconstruct and reposition the hyoid bone.

At last, as illustrated in Figure 1, we ended up with a complete model of the vocal tract, but still we were missing important data such as the tension and density of the vocal cords or the thickness and composition of the soft tissues that take an important role in the human voice.

Figure 1 - *Ötzi's vocal tract reconstructed model.*
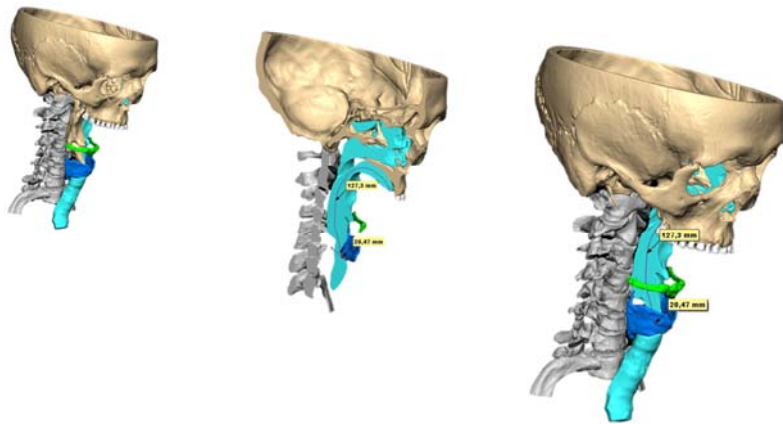
MRI (magnetic resonance imaging) scans would have helped us getting more insights, but this technology could not be used because of the condition of Ötzi's mummified body. Thus, we had only to rely on mathematical models and a software that simulates the way the vocal tract works.

Taking into consideration that, despite its short slender body, Ötzi's had a rather large head, it was possible to hypothesize that his voice could probably have had a fundamental frequency between 100 Hz and 150 Hz, in line with today's average male (voices).

With only these simple measurements and this hypothesized f0 finally, with the help of a specialized software developed by Peter Birkholz of the Institute of Acoustics and Speech Communication of the Technische Universität of Dresden (Birkholz, Lehnert, Neuschaefer-Rube, 2009), we let Ötzi speak with few vowel like sounds or few simple words/sentences.

Bibliography

BIRKHOLZ, P., LEHNERT, B., NEUSCHAEFER-RUBE, C. (2009). VocalTractLab – Ein neues Softwaretool für die artikulatorische Sprachsynthese in der Lehre. In: 26th Jahrestagung der DGPP, Leipzig, Germany, 209–211.