

Using a vocal tract growth model to test phylogenetic hypothesis

The anatomical relationship between the oral and pharyngeal cavities is supposed to differ from our ancestors to today humans. A widespread hypothesis is that the emergence of speech should be attributed to this morphological change in the course of evolution. Pre-hominid and hominid fossils with well preserved skulls and jaws are quite rare, which makes it difficult to test this hypothesis. Indeed, to allow a reconstruction of the larynx, the cervical vertebrae have to be preserved, which is hardly ever the case.

In the other hand, vocal tract ontogenesis (from birth to adulthood) offers an observable variation in which the ratio between pharyngeal and oral cavity is evolving. Hence the interest for a longitudinal skull and vocal tract growth model from the larynx to the lips.

Our study aims at proposing a longitudinal vocal tract growth model included in a skull growth model (because the vocal tract geometry depends on the skull structure), by using X-ray data from the Denver, Iowa and Oregon growth studies. These databases provide longitudinal oro-facial data for 46 subjects from 1 month to 20 years, with one radiograph per year.

The chosen methodology has been used for years in phylogenetic and ontogenetic studies: we identify and mark off bony landmarks and some reference points, which give us the global organisation of the skull and the vocal tract. Then we display bipolar grids, to draw the outlines of the soft tissues. These data are then used to build a longitudinal growth model of the skull organisation, then of the vocal cavity, and finally of the vocal tract, which can help us to study morphological changes and their acoustic consequences.