An improved 3D dynamical finite element model of tongue muscles

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This work aims to present the last significant improvements of the three-dimensional (3D) biomechanical finite element model of the tongue used within our group. The model, based on medical images of a specific patient, has been originally developed by Gérard and colleagues and has undergone significant adaptations and improvements through the past ten years. The new model, made of a full-hexahedral mesh, presents the implementation of 11 groups of intrinsic and extrinsic muscles. The anatomical location of these muscles is defined via various subsets of elements in the mesh derived from the previous works. Fibers from older models are transferred within the new version of the tongue using a semi-automatic method that insure their symmetry with the sagital plane and a consisting repartition inside the tongue volume. Within the 3D model, a distributed lambda model, based on Feldman's lambda Model implemented by Nazari and colleagues, is used to describe the finite-element activation of muscles. The new 3D finite element modeling of the tongue muscles offered the opportunity to investigate the role of each muscle and above all the debated role of the styloglossus. The integration of the tongue model within a 3D biomechanical model of the vocal tract aims to achieve an accurate modeling of swallowing. It consists in developing a fluid model which may represents the food bolus and its interaction with the mechanical structures of the vocal tract.