THE EFFECT OF MASTICATORY LOADING ON THE CERVICAL LOOP REGION OF THE INCISOR IN RODENTS

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ABSTRACT –
Rodents are arguably the dominant model organism for studies investigating the effect of genetic traits on the pathways to mammalian skull development, thus being integral in exploring their craniofacial evolution. Mice mandibles exhibit unique characteristics associated, among others, to the cervical loop region of their incisor hosting a high concentration of epithelial stem cells. As these cells are highly mechanosensitive, it stands to reason that their differentiation could considerably affect the postnatal mandibular growth. The aim of this study was to analyse the functional significance of masticatory loads on the mouse mandible and identify critical stress accumulations that could trigger phenotypic differentiations in their skull morphology.
A 3D model of a rodent's skull was reverse engineered and the main components of the model's mandible segmented. Two masticatory scenarios were identified, incisal biting (gnawing) and chewing at the molars and both of them examined at two load intensities (corresponding to soft and hard pellets). The biting force was countered by a muscle architecture and the temporomandibular joint.
Biting type (incisal or molar) was found to have a dominant effect on the stress variations experienced by the mandible, with biting intensity resulting in an almost linear stress increase.
The simulation provided refined insight on the mechanobiology of the cervical loop of the incisor in mice, indicating that food consistency could exert a dominant role on the endemic stem cell proliferation and differentiation. The results suggest that extracellular forces developing during mastication can influence micro evolutionary divergence patterns in the mouse mandible.