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Magnetic method for 5 Degree-of-freedom jaw position estimation

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ABSTRACT

BACKGROUND: There is a large gap between primitive bruxism detectors and sophisticated clinical machines for jaw kinematics evaluation. Currently, there is no solution for continuous, 24-h jaw motion tracking. In previous work, we proposed a permanent magnet tracking method for calculating linear jaw displacements that could serve as a basis for such device.

OBJECTIVE: To create and confirm a methodology for background-magnetic-field (BMF) resistant, 5-degree-of-freedom (DOF) jaw position determination, using a 3-DOF, permanent-magnet-based linear displacement method.

METHODS: By using data from two adjacent, 3-axial magnetometers in an equation system solved by 'Least square error' algorithm, it is possible to determine and compensate BMF, as well as to solve for permanent magnet position with a better accuracy. If jaw width and temporomandibular joint-to-sensor distances are known, it is possible to derive a relation between jaw linear displacement and angle. Since the jaw is only able to turn in two directions, this allows for a maximum of 5-DOF position determination.

RESULTS: BMF resistant, two-magnetometer position method was confirmed using finite element modelling. Jaw linear displacement to angle dependency was confirmed by comparison to real 6-DOF jaw motion data.

CONCLUSIONS: Proposed method could be implemented in an intra-oral device.

KEYWORDS: 3D jaw tracking, mastication trajectory, bruxism evaluation.