

A 3D non invasive assessment of the position of the occlusal plane

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Introduction. The occlusal plane has a key-role in various dental and medical fields. Several methods have analyzed and measured the relative positions of the occlusal and facial planes; most of these investigations used 2D radiographic exams. Currently, 3D assessments may be performed overlapping CT reconstructions and digitized dental casts, but the method requires ionizing radiations, and it is not applicable in reference studies performed with healthy subjects. The efficacy of these measurements could be improved by a 3D, non invasive approach to the problem.

Methods. 20 healthy subjects were selected to have their maxillary dental casts digitized by laser scanning, and their 3D facial soft tissue stereophotogrammetry acquisition merged in a single file. The digital 3D coordinates of three facial (right and left Tragus, Subnasale) and three dental landmarks (inter-incisor, tips of the mesio-vestibular cuspids of right and left first permanent molars), were obtained and exported in a 3D CAD (computed aided design) software for a geometrical analysis. The 3D orientation of the planes, referred to a Cartesian orthogonal reference system, was estimated calculating angular values between the sagittal midlines of the two planes. To evaluate the repeatability of the measurements the protocol was performed independently by two different operators. In total 120 measurements were obtained; descriptive statistics were calculated for each variable. To evaluate the method repeatability mean absolute difference between repeated measurements (MAD), technical error of measurement (REM) and Paired Student's T tests ($P < 0.05$) were computed.

Results. In the frontal and horizontal projections, the occlusal plane resulted nearly parallel to Camper's plane, with average inclinations of 1.5 (frontal) and 1.9 (horizontal) degrees. In the sagittal projection, the two planes had an average angle of 4.9 degrees, with the occlusal plane more anteriorly inclined than Camper's plane. For all three projections, a fair inter-operator repeatability was found, with all MADs and TEMs slightly lower than 2 degrees. No systematic errors between repeated measurements were found (T test > 0.05).

Conclusions. The current non-invasive method resulted appropriate to the aims. Camper's and occlusal planes resulted almost parallel in the frontal and horizontal projections, while in the sagittal projection the occlusal plane was 5 degrees more anteriorly inclined than Camper's plane.

Keywords: Face, occlusal plane, stereophotogrammetry, 3D