

# POSTER

## **A new methodology for the evaluation of the accuracy of digital implant impression for edentulous jaw.**

Area: Dental Technology and Technical Procedures

University/Department:

University of Padova/Department of Neurosciences

Authors:

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Presenter:

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Objective:

The aim of the present study was to introduce a new method to evaluate the accuracy of digital impression for full-arch implant-supported fixed dental prosthesis.

Materials:

A virtual model of a mandibular edentulous with six scan-abutment positioned vertically at different height was designed by software (CAD) and subsequently manufactured in zirconia by a CNC machine tool (master model). The master model was measured with a coordinate measuring machine (CMM) (SmartScope Flash). The coordinates of the probed points were transferred into a 3D CAD software (Rhinoceros 5.0 Beta) and analyzed with a task specific evaluation protocol to estimate the position and orientation of each scan-abutment. The measuring system is capable of a maximum permissible error (E, in micron) that is 10 times lower than both the performance of scanners commonly used in framework digital manufacturing and the expected position errors of the scan-abutment surfaces:  $E1(z) = 2.5 + 5L/1,000 \text{ ?m}$ ,  $E2(xy) = 1.8 + 5L/1,000 \text{ ?m}$ ,  $E3(xyz) = 2.8 + 5L/1,000 \text{ ?m}$  (with L, in millimeters, equal to the measured distance, according to International Organization for Standardization norm 10360). The master model was directly digitized using five different intraoral scanner (n=15 for group) (Scan A, Scan B, Scan C, Scan D, Scan E).The STL file of the digital impression was sent to Geomagic Studio Software to cleaned the mesh from portions not related to the research and after the STL file was sent to 3D CAD geometric modelling software (Rhinoceros 5.0 Beta). The software called "Scan-abut" was realized as a plug-in for Rhinoceros 5.0. The software "scan-abut" selects automatically the major surfaces of the scan-abutment ( cylindrical and plan area ) using curvature analysis. To evaluate the positional accuracy of each impression, the estimated reference points of the were aligned, using a least-square best fitting algorithm, to the corresponding scan-abutment on the master model; the algorithm "optimizes" the position and orientation of the impression while considering the 3D distances between each scan-abutment and the relative scan-abutment on master model. Three-dimensional distances between reference points of digital impression and reference points of master model along the x-, y-, and z- axes were calculated at each position for all impression. The Wilcoxon matched-pairs signed-rank test (one-tailed) was used to compare groups. The level of statistical significance was set as  $\alpha = 0.05$  and with a statistical power of 80%.

Results:

Statistical significant differences were found between groups. The mean 3D deviation value respect the master model (trueness) was  $31.5 \text{ ?m}$  ( SD  $8.9 \text{ ?m}$ ) for Scan A,  $31.7 \text{ ?m}$  ( SD  $5.1 \text{ ?m}$ ) for Scan B,  $71.3 \text{ ?m}$ ( SD  $55.0 \text{ ?m}$ ) for Scan C,  $365.5 \text{ ?m}$ ( SD  $143.5 \text{ ?m}$ ) for Scan D and  $107.5 \text{ ?m}$ ( SD  $28.1 \text{ ?m}$ ) mm for Scan E. There was no statistically significant difference between Scan A and Scan B (p-value = 0.47), but a significant difference was present between all the groups.

Conclusion:

Based on the results of this in vitro study, the Scan A and the Scan B demonstrated the highest accuracy. Three intraoral scanner device did not achieve the necessary level of accuracy to be used for full-arch implant-supported fixed dental prosthesis.