



# Evaluation of The Accuracy Of 4 Intraoral Digital Scanners When Used by Untrained Dentist

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**Purpose:** Intraoral scanners are described as precise and easy to use tools even for less experienced professionals. However, little data is currently available on the ability of these devices to produce precise and reliable images for clinical use, especially in unexperienced hands. This study aims to evaluate the precision and accuracy of different intraoral scanners used by a young dentist who has never used digital technologies for in vivo oral impressions.

**Methods:** 4 digital scanner models have been selected for the study: A) AADVA iOS100, GC Corporation, Japan; B) Emerald, Planmeca OY, Finland; C) Trios 2, 3Shape, Denmark; D) CS3600, Carestream Health Inc, USA. A single patient was selected as an in vivo scan model. 3 reference points were placed on the patient's teeth in upper left arch. For each device, 5 scans of the arch were performed by a single operator with poor experience in using digital scanners, trained for respecting manufacturer's instructions (scan path and movements). Scan time and number of interruptions and post processing time have been recorded. A PVS impression has been taken to obtain a "gold standard" for comparisons. The distances between the 3 reference points present on each 3D model were measured by 3 different operators using Final Surface™ software (version 6.8.5, Gfal, Germany). For continuous variables, the mean, standard deviation, minimum, median and maximum are calculated. For categorical variables, absolute and relative frequencies are reported. Moreover for each distance, a one way ANOVA has been implemented and Dunnett test has been applied in order to compare all the mean differences with all the scanner and the gold standard.



**GC AadvA iOS100**



**3Shape Trios 2**



**CS3600**



**Planmeca Emerald**

**Results:** The average scan time was 3'57" for IOS100 (average 3,6 interruptions per scan), 2'01" for CS3600 (0,2 interruptions), 2'23" for Trios3 (0,4 interruptions), 2'15" for Emerald (1,6 interruptions). IOS100 proved to be the fastest in preparing the model (post-processing) with 18,4", followed by Emerald (21,8") Trios2 (23,4") and CS3600 (33,8"). Repeatability of the scans was very high since little standard deviations were reported between each set of 5 scans. No statistical differences were reported between different devices.

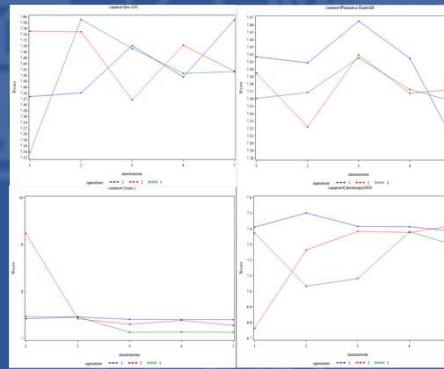


Chart 3: Measures of each devices referring to one distance



Fig 1: three reference points placed on patient's teeth in upper left arch

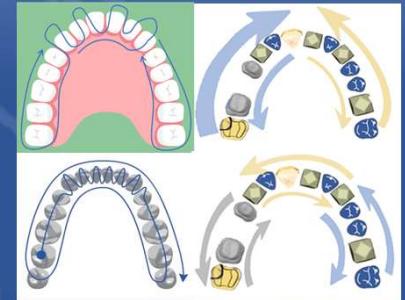


Fig. 2: Scan Path of the four device

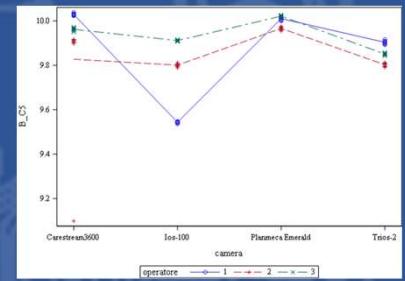


Chart 1: distance between two reference points for each four device, measured by the three operators.

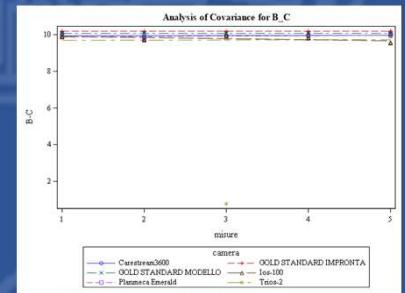


Chart 2: Test Anova with gold standard for all four devices and gold standard (gypsum model)

**Conclusions:** All tested devices appeared to be equally accurate and precise for prosthetic procedures, even if used by a less experienced operator. IOS100 seemed to be the slowest in scanning time, but absolutely the most manageable, being the smallest device and the most comfortable for the patient. CS3600 had the easiest scanning procedure, together with Trios2, but this last appeared to be heavy (750 grams instead of 200-300 of the others) and less manageable due to the shape of the device. Trios2 reported to be more painful by the patient due to edges pressing on cheeks. Emerald was quick in scanning, but seemed the slowest on sharp cusps.