Accuracy and eligibility of CBCT to digitize dental plaster casts

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Study objectives

CBCT scans of plaster models
(8 devices, 10 plaster models)

3D surface rendering

Analysis of accuracy:
Comparison with images from
5 optical devices

AIMS:

In implant dentistry, software assisted planning requires digital casts and oftentimes CBCT radiography. However, buying a dedicated model scanner can be expensive and might not be required. The present study aimed to assess whether digital models derived from CBCT scans and models digitized using a dedicated model scanner are of comparable accuracy.

MATERIALS AND METHOD:

A total of 20 plaster casts were digitized with eight CBCT scanners and five optical devices. Corresponding models were superimposed using six control points and subsequent iterative closest point matching. Median distances were calculated among all registered models. Boxplots were generated and the paired t-test, a Friedman test and a post-hoc Nemenyi-Test were employed for statistical comparison. Results were found significant at $p < 0.05$.

Device	kV	mAs	FOV (cm ²)
Acteon, Whitefox	120	8	8 x 8
Carestream, CS 8100 3D	80	2	8 x 5
KaVo, OP300 3D	90	6,9	8 x 6
KaVo 3D eXam	120	37,07	8 x 8
Morita, Veraviewepocs 3D R100	80	3	8 x 8
Morita, Accuitomo	90	3	10 x 10
Orange Dental, Orange Green 3D	90	6	8 x 5
Planmeca, ProMax 3D Mid	80	12,5	10 x 10

Table 1: Scanning parameters used for the eight CBCT devices (according to manufacturer recommendations).

RESULTS:

All CBCT scanners allowed the digitization of plaster casts, but failed to reach the accuracy of the dedicated model scanners ($p < 0.001$). Median distances between CBCT and 3D scanned casts were 0.064 ± 0.005 mm. Qualitative differences among the CBCT scanners were detected ($\chi^2=85.67$, $p<0.001$), and one CBCT scanner providing a special plaster cast scan mode was found superior to the competitors ($p < 0.05$).

Fig 1: Boxplots presenting the distances among images derived from optical scanners (left) and between images derived from CBCT and optical digitizers (right).

CONCLUSION:

CBCT devices failed to reach the accuracy from 3D scanners, but within the limits of the study, accuracy appeared to be sufficient for digital planning and forensic purposes