# Reproducibility and accuracy of linear measurements on dental models derived from cone-beam computed tomography compared with digital dental casts

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**Introduction:** The aim of this study was to determine the reproducibility and accuracy of linear measurements on 2 types of dental models derived from cone-beam computed tomography (CBCT) scans: CBCT images, and Anatomodels (InVivoDental, San Jose, Calif); these were compared with digital models generated from dental impressions (Digimodels; Orthoproof, Nieuwegein, The Netherlands). The Digimodels were used as the reference standard. **Methods:** The 3 types of digital models were made from 10 subjects. Four examiners repeated 37 linear tooth and arch measurements 10 times. Paired *t* tests and the intraclass correlation coefficient were performed to determine the reproducibility and accuracy of the measurements. **Results:** The CBCT images showed significantly smaller intraclass correlation coefficient values and larger duplicate measurement errors compared with the corresponding values for Digimodels and Anatomodels. The average difference between measurements on CBCT images and Digimodels ranged from −0.4 to 1.65 mm, with limits of agreement values up to 1.3 mm for crown-width measurements. The average difference between Anatomodels and Digimodels ranged from −0.42 to 0.84 mm with limits of agreement values up to 1.65 mm. **Conclusions:** Statistically significant differences between measurements on Digimodels and Anatomodels, and between Digimodels and CBCT images, were found. Although the mean differences might be clinically acceptable, the random errors were relatively large compared with corresponding measurements reported in the literature for both Anatomodels and CBCT images, and might be clinically important. Therefore, with the CBCT settings used in this study, measurements made directly on CBCT images and Anatomodels are not as accurate as measurements on Digimodels. (Am J Orthod Dentofacial Orthop 2014;146:328-36)

In orthodontics, study model analysis is an essential part of the diagnosis, treatment planning, and evaluation of treatment progress.[1-4] When digitalization was introduced in the orthodontic world, digital models became available to replace traditional plaster casts. The most frequently used method to obtain digital dental models is to digitize plaster models or dental impressions. The technology used to generate digital models from dental models or impressions varies considerably. Orthocad (Cadent, Carlstadt, NJ) uses "destructive scanning" with multiple scans of the plaster model cut in thin slices. Emodels (GeoDigm, Falcon Heights, Minn) scans the surface of a complete plaster model. Impressions can also be scanned directly using cone-beam computed tomography (CBCT) technology (Digimodels; Orthoproof, Nieuwegein, The Netherlands).[5]

Digitized plaster models or digital models derived from dental impressions have been shown to be a valid tool for undertaking simple diagnostic measurements such as tooth size, arch width, overjet, overbite, arch length, and Bolton ratio.[6] In a systematic review, Fleming et al[5] found that overall, the mean differences

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