Bone quality evaluation at dental implant site using multislice CT, micro-CT, and cone beam CT

Keywords: bone density, bone volume fraction, dental implants, multislice computed tomography, micro-computed tomography, cone beam computed tomography

Abstract

Objectives: The first purpose of this study was to analyze the correlation between bone volume fraction (BV/TV) and calibrated radiographic bone density (KvG) in human jaws, derived from micro-CT and multislice computed tomography (MSCT), respectively. The second aim was to assess the accuracy of cone beam computed tomography (CBCT) in evaluating trabecular bone density and microstructure using MSCT and micro-CT, respectively, as reference gold standards.

Material and methods: Twenty partially edentulous human mandibular cadavers were scanned by three types of CT modalities: MSCT (Philips, Best, the Netherlands), CBCT (Siemens Sirona, Bensheim, Germany), and micro-CT (Scanco, Brüttisellen, Switzerland). Image analysis was performed using Amira (V.4.1, Visage Imaging Inc., Carlsbad, CA, USA). BONEQ software (v.3.2.3, Skyscan, Kontich, Belgium). BV/TV and trabecular bone density were derived. Statistical analysis was performed to assess the correlations between corresponding measurement parameters.

Results: Strong correlations were observed between CBCT and MSCT density (r = 0.899) and between CBCT and micro-CT BV/TV measurements (r = 0.820). Excellent correlation was observed between MSCT HU and micro-CT BV/TV (r = 0.818). However, significant differences were found between all comparison pairs (p < 0.001) except for mean measurement between CBCT BV/TV and micro-CT BV/TV (p = 0.147).

Conclusions: An excellent correlation exists between bone volume fraction and bone density as assessed on micro-CT and MSCT, respectively. This suggests that bone density measurements could be used to estimate bone microstructural parameters. A strong correlation also was found between CBCT grey values and BV/TV and their gold standards, suggesting the potential of this modality in bone quality assessment at implant site.