Accuracy of trabecular bone microstructural measurement at planned dental implant sites using cone-beam CT datasets

Key words: cone-beam computed tomography, dental implants, microarchitecture, micro-computed tomography, trabecular bone

Abstract

Objective: Cone-beam CT (CBCT) images are increasingly utilized for trabecular bone microstructural measurement due to the system's limited resolution. The aim of this study was to determine the accuracy of CBCT for measuring trabecular bone microarchitecture in comparison with micro-CT (μCT).

Materials and methods: Twenty-four human mandibular cadavers were scanned using a CBCT system (80 μm) and a μCT system (35 μm). Three bone microstructural parameters trabecular number (Tb.N), thickness (Tb.Th) and separation (Tb.Sp) were assessed using CT imaging software.

Results: Interclass correlation coefficients (ICC) showed high intra-observer reliability (≥ 0.996) in all parameters for both systems. The Pearson correlation coefficients between the measurements of the two systems were for Tb.N 0.82, for Tb.Sp 0.74 and for Tb.Th 0.81 (all P < 0.001). The Bland and Altman plots showed strong agreement in Tb.N (−0.37 μm) followed by Tb.Th (0.00 μm) and Tb.Sp (0.85 μm).

Conclusions: Cone-beam CT datasets can be used to evaluate trabecular bone microarchitecture at dental implant sites. The accuracy for measuring Tb.N was the best followed by Tb.Th and Tb.Sp.

The influence of bone quality on implant success is well acknowledged. Information of bone quality is best gained by combining bone mineral density (BMD) and trabecular structure assessments (Felsenberg & Bonnen 2006).

Trabecular bone is the source of osteoclasts and osteoblasts which are largely responsible for the physiological changes (Manoogian & Filli 1993) which take place subsequent to implant placement (Marin et al. 1999). The role of trabecular microstructure in dental implants is significant because the implant is surrounded by trabecular bone which directly contributes to implant stability (Paracca & Chang 2004, Sukka & Cudkind 2009). Radiography information of the trabecular microstructure can be achieved using high-resolution imaging modalities that approach.