An approach in quantification of the alveolar bone changes related to dental implant placement based on 3-D CBCT images

Xiaoli Cheng, Lifong Zou, Alessia D’Onofrio, Nikos Mardas, Nikolaos Donos; Bart’s and The London School of Medicine and Dentistry, QMUL, UK

Introduction
• Dental implants has become one of routine treatments modality and shows reliable long-term results.
• A contemporary problem is the esthetic maintenance of tissue levels following dental implant placements.
• Bone preservation - a key factor for enhance the eventual dental implant esthetic outcome.
• Advantage or disadvantage of different operation time points in alveolar ridge preservation is still inconclusive.
• Advantage of CBCT – Lower radiation dose, Rapid scan time, Higher image accuracy, and Chair-side 3D image display.
• Disadvantage of CBCT - Metallic artifact on CBCT image influences measurements.

Objectives
• To establish an accurate and reproducible geometric measurement strategy that can precisely quantify alveolar bone changes related to the implant surgical procedure, based on CBCT images taken at before and one year after implant placement

Measurement strategy
1. Superimposition images of two CBCT data sets taken at pre & a year post implant surgery and obtain a comparison of the two images (Fig.1)
2. Determination of the measurement position of bone thickness and height that avoided the influence of metal artifacts (Fig.2)
3. Establishment of a reproducible and accurate measurement strategy based on the combination of grey shade and grey value (Fig. 3, Fig.4)
4. The reproducibility and accuracy were assessed by measuring a standard implant placed in a dry mandible with four CBCT parameter settings and each measurement was repeated three times.

Results & Conclusion
• The method based on the combination of grey shade and grey value produced the best reproducibility and accuracy as shown in Fig.5 & Fig.6;
• The measurements of bone changes in thickness and height: at buccal side ΔB1:0.1, ΔB2:0.2, ΔB3:0.3mm, -0.08, -0.03mm; Lingual side ΔL1:0.1, ΔL2:0.2, ΔL3:0.2mm were -0.51mm, -0.09mm, -0.06mm respectively and height changes were ΔH1: -0.3mm & ΔH2: -0.8mm;
• The measurement strategy established from this study is meaningful.


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