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Accuracy of quantitative digital subtraction radiography for determining changes in calcium mass in mandibular bone : an in vitro study

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Résumé / Abstract
The aim of this in vitro study was to determine the accuracy of digital subtraction radiography (DSR) to detect small changes in calcium mass in alveolar bone adjacent to tooth roots. In each of 4 dried porcine mandible segments, one interproximal and one buccal defect region was defined adjacent to a premolar root. A series of cortical and cancellous bone slices with a 50 µm-stepwise increasing thickness (0-5000 µm) were attached to the mandible segments covering the respective defect region. Standardized radiographs were quantitatively assessed for density changes using DSR. After dissolving each bone slice in hydrochloric acid, its calcium concentration was photometrically determined. For each bone slice, the mean calcium mass covering a single pixel of the subtraction image was calculated. The Wilcoxon signed-rank test and the Mann-Whitney U-test were used for statistical analysis ($\alpha = 0.05$). A strong linear correlation ($r^2 = 0.86$-1.00; $p \leq 0.001$) was found between the thickness of the bone slices and their calcium mass. Cortical bone showed a 3.5 times higher mean calcium mass/pixel than cancellous bone. Furthermore, a strong linear correlation ($r^2 = 0.63$-1.00; $p \leq 0.001$) was found between the mean calcium mass per image pixel and the radiographic density changes. Neither the bone type nor the defect localization had a significant influence on radiographic density changes caused by changes in calcium mass. A change in mean calcium mass per image pixel of 0.1-0.15 mg was necessary to be detected by DSR. In conclusion, this study revealed a high accuracy of DSR to detect small changes in calcium mass in alveolar cortical and cancellous bone.

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