Quantification of periapical bone destruction in mice by micro-computed tomography.

Bacterial infections of the dental pulp result in tissue destruction and periapical bone resorption. The availability of genetically engineered mouse strains is a major advantage in the use of this model system for studies of periapical pathogenesis. The main limitation of the mouse model is its small size, and the necessity for laborious histologic analyses to quantify periapical bone destruction. In the present study, we evaluated the use of a new technology, high-resolution micro-computed tomography (micro-CT), for the rapid and non-invasive quantification of periapical bone destruction. Periapical lesions were induced in the lower first molars of mice by exposing the pulp to the oral environment. Mandibles were harvested on day 21 after pulp exposure, and were subjected to micro-CT analysis, with 17-microm-thick radiographic sections. Samples were then decalcified, embedded, and sectioned for histology. The cross-sectional area of periapical lesions was determined by image analysis of corresponding micro-CT and histologic sections. The results showed a highly significant correlation between micro-CT and histology ($p < 0.0001$), with mean differences of 4. 1% (range, 0.9 to 7.2%) between the two methods. The mean error associated with image analysis was 4.9% for images obtained by both micro-CT and histology. The variability of replicate ($n = 5$) independent micro-CT determinations was 3.4%, less than that associated with the image analysis error. These results demonstrate that micro-CT imaging is a rapid, reproducible, and non-invasive method, that gives results that are closely comparable with those obtained by histology. Micro-CT appears to have utility for the accurate quantification of changes in bone architecture in small biological specimens.