

EFFECT OF IMAGE ENHANCEMENT AND COLOUR CONVERSION ON LESION DETECTABILITY FROM CONVENTIONAL AND DIGITIZED RADIOGRAPHS

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ABSTRACT

Validity of image enhancement and colour conversion on bone lesion detectability from periapical radiographs was investigated. A comparison was made between conventional and digitized radiographs before and after contrast enhancement and colour conversion from one side and digitized non-enhanced and contrast enhanced, colour converted radiographs from the other side. A total of 150 defects were made in 10 well preserved, dry human mandibles with 15 defects randomly distributed at the premolar-molar region of each mandible. Defects were made of different sizes using different sized round burs. Each site was radiographed 10 times at a different exposure time ranging from 0.10 to 1.0 second to obtain radiographs of varying densities. The radiographs were developed and scanned on a flat-bed full colour scanner with automatic transparency adapter. The digitized radiographs were loaded into computer memory, enhanced and colour converted using Saudi enhancer program. The images were displayed on a flat 15" colour monitor. Conventional radiographs and digitized images before and after enhancement and colour conversion were examined by ten trained observers to detect the number of defects in each radiograph. The results showed that contrast enhanced and colour converted digitized radiographs significantly improved lesion detectability compared to conventional and digitized non-enhanced radiographs. It was concluded that the application of digital radiography with contrast enhancement is a sensitive method for detecting subtle tissue changes, with a possibility of improving existing images of low quality instead of taking another exposure.

INTRODUCTION

Intra-oral conventional radiographs have long been the primary diagnostic method for assessment of osseous changes due to periodontitis and for evaluating the effect of periodontal therapy on alveolar bone^(17,25). Shortcomings of radiographs as a basic diagnostic tool of inflammatory periodontal disease are due to the fact that they fail to show early lesions, underestimate destruction in advanced lesions and fail to distinguish between treated and untreated areas⁽²³⁾. In addition, it is difficult to detect subtle osseous changes due to the presence of structured noise consisting of anatomic features that are not of specific diagnostic interest by conventional radiographs^(14,35).

In order to increase the detectability of changes in the radiographic pattern when two radiographs are to be compared, structured noise must be reduced through elimination of identical structures in the image. This is achieved by a method or technique known as digital subtraction radiography⁽¹⁶⁾.

Hardstedet et al.⁽²⁰⁾ reported that Ziedes des Plantes was the first to use subtraction radiography in the field of angiography before and after injecting a contrast medium. The subtraction technique had already been introduced to dental radiology by Ruttiman and colleagues⁽³⁶⁾

and was found to be a feasible method that increases accuracy of detection of density changes between radiographs⁽³⁰⁾. The method was found to be useful in the detection of periodontal bone density changes, first in in-vitro studies^(16,17,37,43) and later in many clinical applications such as in dental caries studies^(15,19), in evaluating the effect of periodontal therapeutic procedures on crestal bone changes and molar furcation defect fill^(5,8,10,11,21,22,34,39) and in the assessment of peri-implant bone changes^(12,29).

The idea of digital subtraction technique is based on superimposition of two radiographs, achieving an overlap of identical anatomic structures in the image, after which the homologous information in one image is subtracted from that in the other. This is achieved by a special computer software programme and a video camera or a scanner which convert the processed radiographs into images⁽⁴⁵⁾. However, serial radiographs obtained from clinical study vary in optical density because exposure factors and processing conditions change randomly during routine procedures. The difference in contrast between radiographs leaves structured noise in subtraction images, which hinders detection of small lesions. This noise can be removed using an adequate contrast correction method before subtraction^(32,36,38).

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