PROXIMAL DENTAL CARIES DETECTION BASED ON SUBTRACTION METHOD IN THE CARIES MODEL

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INTRODUCTION

Dental caries is known as decay process on the tooth surface and is a disease where bacterial processes damage hard tooth structure. A large proportion of dental caries involves with the proximal surfaces of the deciduous teeth [1]. Therefore, in dentristry, one of the most frequent radiographic analysis is to determine the presence or absence of proximal dental caries and choose an appropriate therapy when caries is determined to be present. However, although various diagnostic methods to detect carious lesions of the dental proximal surface are used, it is still very difficult to do accurate interpretation of the proximal dental caries.

This study investigates how to detect proximal caries using digital subtraction radiography in the artificial caries model. The proposed detection method was tested on the radiographic dental images with artificial carious lesions.

METHODS

In order to design the artificial caries model, five human teeth with unsoiled proximal surface were first prepared. After washing and drying processes, to induce artificial proximal carious (demineralization), all teeth were painted twice by nail varnish except for proximal caries susceptible zone marked by 1.5mm round shape window at proximal area. Then, each tooth was exposed for 30–120 min to a 100 ml acetic acid buffer solution containing 3.0 mmol/l calcium and 1.7 mmol/l phosphate. 10% perchloric acid solution was also added to make rapid progress of carious lesions.

Five teeth mounted on rubber blocks (Figure 1a) were radiographed by the designed extension cone paralleling (XCP) device (Figure 1b). Each image was radiographed by the Heliodent DS mobile intraoral x-ray unit at the voltage potential of 60 kVp and the anodic current of 7 mA with exposure times of 0.32 s. Images were acquired by Kodak RVG 6100 digital radiography system under 1140×1920 pixels and a resolution of 20 lp/mm.

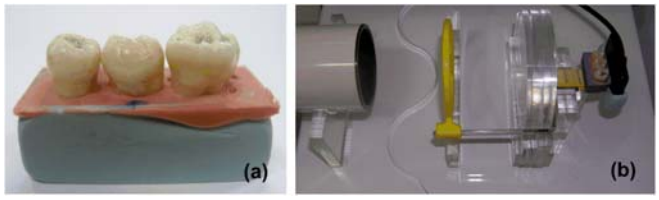

Figure 1: Human teeth block with sound surfaces and proximal artificial cavities (a) and geometrically standard-ized experimental design (b).

RESULTS AND DISCUSSION

In artificial caries model, the range of lesion depth was 572–1374 μm and the range of lesion area was 36.95–138.52 mm^2 (Table 1). The lesion depth and area were significantly increased with demineralization time (p<0.001). The raw radiographic dental image and that with artificial carious are shown in Figure 2(a) and (b). With the proposed subtraction method based on single image, the final image is shown in Figure 2(c). Therefore, the proximal caries detection using digital subtraction radiography showed accurate detection results compared to the proximal caries examination using conventional digital radiograph way.

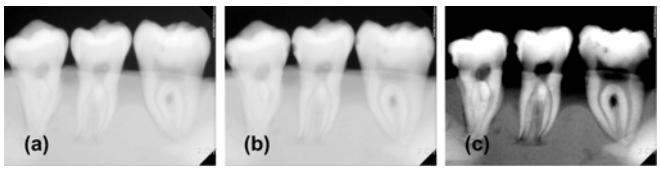

Figure 2: Raw image (a), image in artificial cavity (b), the resulting image obtained by subtraction method (c).

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Table 1: Mean lesion depth and lesion area of specimens in accordance with demineralization time

Demineralization time (min)	No. of proximal carious	Lesion depth (μm)	Lesion area (mm^2)
30	8	572.55 ± 191.15	36.95 ± 16.40
60	8	851.55 ± 300.40	60.59 ± 32.20
90	8	1167.21 ± 195.05	106.58 ± 37.09
120	8	1374.27 ± 153.52	138.52 ± 32.89