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COMPARISON BETWEEN INVERTED AND UNPROCESSED DIGITIZED RADIOGRAPHIC IMAGING IN PERIODONTAL BONE LOSS MEASUREMENTS

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ABSTRACT

The advances in digital imaging technology in dentistry have provided an alternative to film-based radiography and have given new options to detect periodontal bone loss. The purpose of this study was to compare inverted and unprocessed digitized radiographic imaging in periodontal bone loss measurements. Thirty-five film-based periapical radiographs of patients suffering from moderate to advanced untreated periodontal bone loss associated to lower premolar and molars was selected from the department files, with 40 bone loss areas. The film-based radiographs were digitized with a flatbed scanner with a transparency and radiograph adapter used for transilluminating the radiograph imaging. Digitization was performed at 600 dpi and in gray scale. The images were digitized using Image Tool software by applying image inversion, that is, transformation of radiopaque structures into radiolucent structures and vice-versa. The digital data were saved as JPEG files. The images were displayed on a 15-inch and 24-bit video monitor under reduced room lighting. One calibrated examiner performed all radiographic measurements, three times, from the cementoenamel junction to the most apical extension of the bone loss, in both types of image (inverted and unprocessed). Brightness and contrast were adjusted according to the examiner's individual demand. Intraclass correlation coefficient was used to compare the measurements from both types of images. The means of radiographic measurements, in mm, for inverted and unprocessed digitized imaging were 6.4485 and 6.3790, respectively. The intraclass correlation coefficient was significant (0.99) The inverted and unprocessed digitized radiographic images were reliable and there was no difference in the diagnostic accuracy between these images regarding periodontal bone loss measurements.

Uniterms: Radiography, dental; Digital processing; Bone loss/diagnosis.

INTRODUCTION

Progression of periodontal disease leads to periodontal bone loss with resorption of the alveolar crest and tooth mobility and it is considered one of the most prevalent oral diseases in adult population. The clinical and radiographic examinations play an important role in the diagnosis and management of the disease.

The advances of digital imaging technology in dentistry have been an alternative to film-based radiography and have given new alternatives to detect periodontal bone loss[4,9,10]. This technology has allowed image manipulation, such as conversion of the film-based radiographs into digitized images that can be exhibited on a monitor. The digitized images can enhance radiographic interpretation, with use of resources such as brightness and contrast control, colorization, and inversion effects that may be applied to the radiographic image[9] and can be useful in evaluating bone loss and treatment efficacy[9,10]. Outcome measures for digitized images include direct measurement of bone height along the root surface using software.

Studies concerning the accuracy in the detection of bone loss with film-based and digitized images showed no differences among these two radiographic systems[3,7,11]. On the other hand, when the interproximal bone loss was evaluated using the film-based and digitized methods, and the results compared with measurements during surgical procedures, the radiographic methods underestimated periodontal bone loss. Among the radiographic methods, the digitized one underestimated the interproximal bone loss less than the film-based one[2].

There is one published paper[3] that used inverted radiographic image to compare linear radiographic measurements and measurements during surgical procedure for the interproximal bone loss and the results showed no

statistically significant differences among digitized, inverted or conventional methods regarding surgical measurements.

It is reasonable to assume that the early detection of periodontal bone loss should be evaluated by inverted digitized imaging using Image Tool software because there is a lack of studies addressing this issue. The aim of this study was to compare bone loss measurements between inverted and unprocessed digitized radiographic imaging.

MATERIAL AND METHODS

A total of thirty-five film-based periapical radiographs of patients suffering from moderate to advanced untreated periodontal bone loss of lower premolar and molars were selected from the department files with forty bone loss areas. The radiographs were selected on the basis of no probabilistic sampling with the selection criteria of high-quality radiographs, which present maximum sharpness, ideal contrast, and density with no metallic restorations and or proximal overlapping.

The film-based radiographs were digitized with a flatbed scanner (Snapscan TPO, Agfa, Taiwan, China) with a transparency and a radiograph adapter (Snapscan 1236 s, Agfa, Taiwan, China) used for transilluminating the radiograph image. Digitization was performed at 600 dpi and in gray scale. The digitized images were manipulated with Image Tool software (Image Tool, San Antonio, TX, USA) using image inversion, that is, transformation of radiopaque structures into radiolucent structures and vice-versa.

The digital data were saved as JPEG files. The images were displayed on a 15-inch and 24-bit S-VGA video monitor (Sync Master 500b, Samsung, Serebran, Malaysia) under reduced room lighting. One calibrated examiner performed all radiographic measurements, three times, from the cementoenamel junction to the most apical extension of the bone loss, in both types of image (inverted and unprocessed). Brightness and contrast were adjusted in accordance with the examiner's individual demands.

Image Tool software was also used to perform the measurements. The reference points were marked in the images and the program calculated the distances in pixels, giving the mean and standard deviation. The results in pixels were converted into mm based on a known dimension in mm using a calibrated spatial tool (Figure 1).

Statistical Analysis

The comparison of bone loss measurements between inverted and unprocessed digitized radiographic imaging was evaluated. Intraclass correlation coefficient (ρ)[6] was applied to verify if both types of images were reliable. The level of significance was 5% for the decision-making.

RESULTS

Coefficients of variation of bone loss measurements in inverted and unprocessed digitized radiographic imaging, means and standard deviations are presented in Table 1.

The bone loss measurements in both types of imaging were very similar (6.4485 and 6.3790).

The intraclass correlation coefficient was highly significant

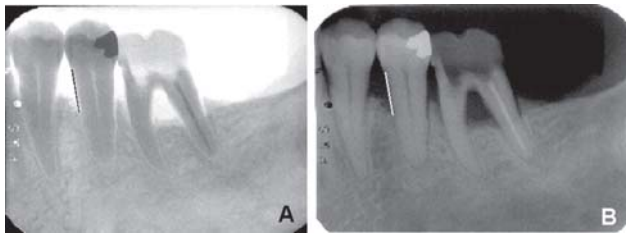

FIGURE 1- Digitized radiographic images: inverted (A) and unprocessed (B) showing the bone loss measurements (black and white lines), from the cement enamel junction to the most apical extension of the bone loss

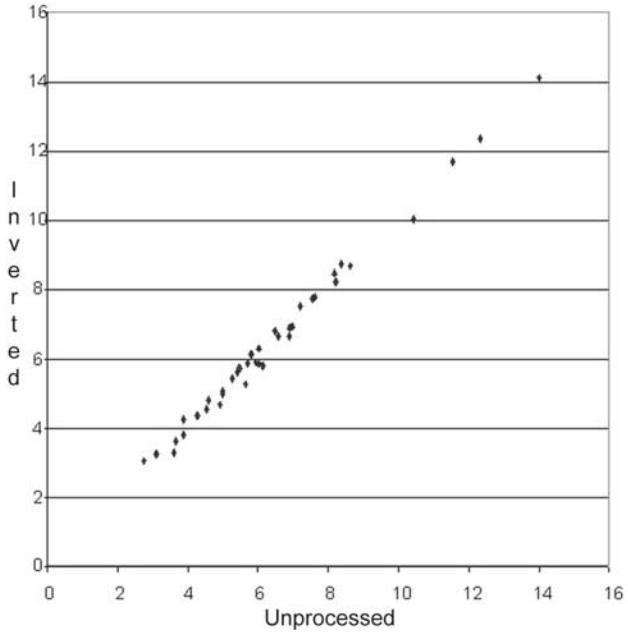

FIGURE 2- Linear measurements according to the type of radiograph (I= inverted and U=unprocessed)

TABLE 1- Means, standard deviations (SD), coefficients of variation of bone loss measurements (mm) in inverted and unprocessed digitized radiographic imaging

	Inverted	Unprocessed
Mean ± SD	6.4485 ± 2.4425	6.3790 ± 2.4427
Coefficient of variation (%)	37.88	38.29

(ρ =0.99) and positive between bone loss measurements in inverted (I) and unprocessed (U) imaging (Figure 2). Thus, both types of imaging presented an almost perfect agreement with the same reliability in the bone loss measurements.

DISCUSSION

The experimental question to be addressed in this study was whether the inverted digitized radiographic imaging provides higher efficacy than unprocessed digitized imaging. The results showed that regardless of digitized inverted imaging, there is no difference between bone loss measurements, in both types of imaging, from inverted and unprocessed digitized radiographic, which indicates that both methods presented the same reliability.

Although digital imaging technology in dentistry has given new options to detect periodontal bone loss[4,9,10] and digitized images should enhance radiographic interpretation, the results of the present study showed no differences between manipulated imaging, such as an inversion, when comparison was made with unprocessed digitized imaging. This result might be explained by the nature of radiographic interpretation tasks, such as the linear measurement and by the examiner's calibration, which was trained to read inverted radiographs. The results show that there is no difficulty to interpret inverted digitized imaging.

There are some computer programs that can be applied for digitized radiographs, allowing the manipulation of the radiographic imaging, as well as having a tool that gives linear measurements, which are commonly used for assessing periodontal bone loss[2,3,9-11]. In the present study, the software of choice was Image Tool, which has been developed by the team from University of Santo Antonio (Texas, USA) specifically for dental applications and can be easily downloaded from the internet. As far as it could be ascertained, there is no published paper using this program for detection of bone loss.

Studies using film-based radiographs for assessment of periodontal bone loss are common. In a number of studies comparing direct digital systems and film-based imaging, manipulated or not, related to periodontal bone loss, it has been shown that there is no difference among them[1,5,8]. Although we have evaluated digitized images, the results of the present study are consistent with those published elsewhere.

Digitized radiographic imaging for assessing periodontal bone loss has been used in previous studies[3,7,12], but no study employed Image Tool software and only one used digitized inverted imaging[3]. The results of the present study are consistent with the findings of this one. However, Eickholz et al.[2] (1998) using a computer-assisted analysis system to assess periodontal bone loss in digitized radiographs compared to film-based radiograph, found that film-based imaging provided better quality than digitized radiograph when bone loss was evaluated.

The outcomes of the present study showed that the periodontal bone loss can be measured with the same reliability using inverted digitized radiographic imaging or unprocessed digitized radiographic imaging.

CONCLUSION

Inverted and unprocessed digitized radiographic imaging was reliable and there was no difference in the diagnostic accuracy between these types of image in periodontal bone loss measurements.

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