DIAGNOSTIC EFFICACY OF DIGITAL AND CONVENTIONAL RADIOGRAPHY IN PERIAPICAL BONE LESIONS

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ABSTRACT

The only sign of chronic apical periodontitis is periapical lesions that are seen in radiographs. Lesions are visible when the inflammation reaches cortical plates. Lesions located in cancellous bone, cannot be easily seen in radiography. Developing computerized technology in radiography, which has numerous advantages and its show up devices in the market, encourage the clinicians to take advantage of this technology. It has accessory image processing softwares such as color spectrum. Most currently available systems provide facilities for color conversion of gray scale images. Humans can distinguish much more colors than shades of gray. The aim of this study was to evaluate the diagnostic efficacy of color conversion in diagnosing the periapical lesions located in cancellous bone.

10 premolar teeth were placed in bony sections of the cadaver mandibles. To make sure that there hasn’t been any periapical lesions in sections previously, conventional radiographs were taken. In the next step, simulated periapical lesions were prepared artificially in the buccal or lingual cancellous bone. Then, direct and indirect conventional and digital images were taken. Digital black and white images were converted to colored images using the image processing system. Five observers were asked to determine the presence, location and size of the lesions.

Statistical analyses revealed that color conversion of digital radiography is more accurate than black and white digital and conventional radiography in determining the presence, location and size of the lesions.

In conclusion transforming the gray values of digital images into a color spectrum can improve the detection of bone loss. This is a useful tool for diagnosing the lesions located in cancellous bone.

Key words: Digital Radiography, Bone lesion, Colored Spectrum.

INTRODUCTION

A periapical bone lesion visualized by radiography is the only sign of asymptomatic apical periodontitis. When a lesion is located in cancellous bone, the ability to detect it, would be a significant clinical asset. Several studies have been conducted to determine the limitations of conventional radiographs for detection of cancellous bone defect. The conclusion of these studies is that lesions in cancellous bone cannot be detected radiographically. Lesions detection doesn’t occur until the cortical thickness is changed or at least until the

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junction of cortical/medullary bone is penetrated. This is due to the bone density and randomness of cancellous bone structure. The development of digital radiographic methods has made it possible to reduce the radiation dose and to enhance the image quality after image acquisition. Since the early 1980 subtraction radiography has been used orally for imaging of loss or gain bone. This technique increased the diagnostic accuracy in the detection of small periapical density changes as compared with conventional radiography. However, the subtraction technique is required between the images to be subtracted.

An alternative of extracting more information is to use various kind of enhancement of special features, such as accessory image processing software’s like calor spectrum. Most currently available systems provide facilities for color conversion of gray scale images. Humus can distinguish much more colors than shades of gray.

The aim of this study was to compare the diagnostic efficacy of conventional radiography, and digital radiography with color conversion in diagnosing the periapical lesions located in cancellous bone.

MATERIALS & METHODS

Six cadaver mandibles were used for this study. They were sectioned vertically to include the area between canine-region through the first molar. A diamond disk mounted on a slow-speed straight handpiece was used to section the jaw. Care was taken to avoid involving the periradicular areas of the teeth to be studied. Ten sections were made using this method. Conventional radiographs of these sections were taken to determine the presence of any preexisting periapical pathosis. The bone specimens were mounted in a silicon paste block. The E-speed film (Ekta speed, Eastman-kodak Co., Rochester, N.Y.) was placed in a holder on the lingual side of the specimens. The X-ray tube was placed on the buccal region with the collimator opening parallel to the film, using long cone technique. Twelve images were produced in the same manner.

Only those sections in which there were no preexisting periapical lesions were selected, a total of ten premolar teeth from twelve sections were selected for the study.

The bone sections were examined with direct digital radiographs. The digital sensor used in this study was DIX12 (Planmeca, Finland) with the size of 23.1 x 40.8 mm. Its resolution was 26 P1/mm and the image resolution was 13-26 P1/mm. The pixel size of images was 19 to 30 micrometer. The monitor displayed the images on a 12-bit gray scale, corresponding to 4096 gray levels.

The sensor placed in the lingual region of bone specimens in a silicon paste block. The X-ray table was placed on the buccal region with the collimator opening parallel to the sensor, using long no technique. Ten digital images were produced. The images were stored in the computer in their original form, contrast and brightness.

One artificial lesion were created at the periapex of each specimen that involved the lamina dura. The lesions were created using a slow-speed straight handpiece with either a #4 or #8 round bur. In five specimens lesion were created using #4 round bur and other with #8 round bur.

In half of the total ten specimens lesions were in the lingual region and in others, in the buccal region. Caution was used to avoid involving the buccal and lingual cortical plates.

Direct conventional radiographs were produced with the previous technique that was mentioned. Indirect conventional radiographs with 20° degree horizontal were produced. So each specimen had two images, direct and indirect. A total of twenty conventional images were produced.

Direct and indirect digital images were produced using the same procedure. These images then converted into colored images using the color conversion software of images processing system. Then twenty colored images were produced that contained blue-yellow-orange and red.

Five observers, two oral radiologists and three endodontists participated in this study. They were asked to determine the presence, location and size of the lesion. They were allowed to process the image in the way they preferred in order to obtain what they found to be the best possible presentation, that is a subjective evaluation of image quality. The total of 80 images (conventional an digital) were given to them.
with a questioner. They determined the presence, location and size of the lesions.

RESULTS

There was statistically significant differences between colored digital radiography and black and white digital and conventional radiographies in determining the presence of lesions.

However, there was no significant differences between black and white digital and conventional radiographies (Table 1, Graph 1).

But there was significant differences between colored digital radiography and black and with digital and conventional in determining the size of the lesions. While there was no significant differences between black and white digital and conventional radiographies (Table 2, Graph 2).

And the differences between colored digital and black and white digital and conventional radiographies were significant in determining the location of lesions, while there was no significant differences between 2 black and white radiographies (Table 3, Graph 3).

TABLE 1: COMPARISON BETWEEN 2 DIFFERENT RADIOGRAPHIES IN PRESENCE OF BONE LESIONS

<table>
<thead>
<tr>
<th></th>
<th>Black and white digital radiography</th>
<th>Conventional radiography</th>
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<tbody>
<tr>
<td>Colored spectrum</td>
<td>$X^2=49.8$</td>
<td>$X^2=58.1$</td>
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<tr>
<td>Of digital radiography</td>
<td>$P=0.00$</td>
<td>$P=0.0$</td>
</tr>
<tr>
<td>Black and white digital</td>
<td>-</td>
<td>$X^2=0.502$</td>
</tr>
<tr>
<td>radiography</td>
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<td>$P=0.478$</td>
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</tbody>
</table>

Graph 1: Percentage of visualized bone lesions by different radiographies

TABLE 2: COMPARISON BETWEEN 2 DIFFERENT RADIOGRAPHIES IN DIAGNOSIS OF LOCATION OF BONE LESIONS

<table>
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<tr>
<th></th>
<th>Black and white digital radiography</th>
<th>Conventional radiography</th>
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<tr>
<td>Colored spectrum</td>
<td>$X^2=39.3$</td>
<td>$X^2=57.54$</td>
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<tr>
<td>Of digital radiography</td>
<td>$P=0.00$</td>
<td>$P=0.0$</td>
</tr>
<tr>
<td>Black and white digital</td>
<td>-</td>
<td>$P=0.008^0$</td>
</tr>
<tr>
<td>radiography</td>
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Graph 2: Percentage of diagnosis of location of bone lesion by 3 different radiographies

TABLE 3: COMPARISON BETWEEN 2 DIFFERENT RADIOGRAPHIES IN DIAGNOSIS OF SIZE OF BONE LESIONS

<table>
<thead>
<tr>
<th></th>
<th>Black and white digital radiography</th>
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<td>Colored spectrum</td>
<td>$X^2=34.77$</td>
<td>$X^2=41.54$</td>
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<td>Of digital radiography</td>
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<td>Black and white digital</td>
<td>-</td>
<td>$X^2=0.457$</td>
</tr>
<tr>
<td>radiography</td>
<td></td>
<td>$P=0.499$</td>
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</table>

Graph 3: Percentage of diagnosis of location of bone lesion by 3 different radiographies
DISCUSSION

The only sign of apical periodontitis is periapical lesion, that are seen in radiographs. Lesions are visible when the inflammation reaches into cortical plates. Lesions located in cancellous bone, can not be easily seen in radiographs. In this study for evaluating the diagnostic efficacy or color conversion radiographs in diagnosing the periapical lesions located in cancellous bone, we chose mandibles of cadaver the same as Folk8, Kullendorff9,10 and Douglas11 study. In using cadaver mandibles we could make sure that there wasn’t any preexisting lesions and we made lesions in different places and sizes by ourselves and we had accurate information about these.

For the ability of repeating radiographs in a same condition, all of them by parallel technique produced with long cone. In addition bone specimens were mounted in a silicon paste block and the film or sensor, placed in the holder. Five observers namely two radiologists and three endodontists participated in this study. They were required to answer to three questions in the questionnaire: presence, location and size of lesions.

The data collected from this study illustrated the best diagnostic efficacy of colored digital radiography for all three questions while the difference between black and white digital radiography and conventional radiography was not significant.

The reason of this is because of the diagnosing efficacy of colored images due to high dynamic range. In black and white images observers should distinguish a lesion in shades of gray but in coloured images there are different colors such as colors in the rain bow that could increase the diagnostic efficacy. In this study there weren’t any statistically significant differences between black and white digital radiography and conventional radiography as was in Kullendorff studies8,10.

We used “SLOB” technique in this study to give observers more information about lesions by separating buccal and lingual plates in images. It was useful for diagnosing lesions in black and white digital radiography and conventional radiography but it hadn’t any significant differences for diagnosing in colored image because this radiography has a high potential to diagnose the lesions itself. But in black and white images presence of lesion makes changes in total contrast that are more visible by changing the direction of X-ray exposure and increases the diagnostic efficacy.

CONCLUSION

In conclusion, transforming the gray values of digital images into a colour spectrum can improve the detection of bone loss. This is a useful tool for diagnosing the lesions located in cancellous bone.

REFERENCES

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