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Study of Effect of Adaptive Histogram Equalization on Image Quality in Digital Preapical Image in Pre Apex Area

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Abstract: Comparing direct digital radiographs before and after processing with Adaptive Histogram Equalization (AHE) in order to detect the effectiveness of this option on diagnostic ability of images in pre apex area. In this study, 28 digital radiographs were evaluated and were scored from 1-5 for three different anatomical areas by three dentists who were expert in reading digital radiographs. Then, we processed the images with adaptive histogram equalization. Each reading was first done on unprocessed radiograph (single view) and then re-done with image processed with adaptive histogram equalization displayed beside the unprocessed version (twin view). Histogram equalization of images by the way of increasing contrast were caused in increasing the diagnostic ability of lamina dura and root apex in maxilla and lamina dura, bone trabeculation and root apex in mandible. But, quality of diagnosing of bone trabeculation in maxilla was decreased by this method. Displaying a dental image processed with adaptive histogram equalization together with unprocessed image may enhance the subjectively evaluated image quality, thereby providing extra information for the dentist. The twin view procedure facilitates the discerning of root apex in preapical images with suboptimal quality.

Key words: Digital images, dental radiography, digital radiography, dental

INTRODUCTION

Digital imaging has the potential to improve diagnostic accuracy and make quantative diagnose. (Whites and Pharaoh, 2004; Pretty, 2006). In recent decades soft ware for radiographic analysis has been developed. An adaptive histogram is a useful tool for clinical assessment. An adaptive techniques working on small ports of image at a time (Whites and Pharaoh, 2004; Sund and Moystad, 2006; Sound and Eilertsen, 2007).

An adaptive technique enhanced image can therefore, be displayed routinely together with the unprocessed image to assist in reading difficult images (Sund and Moystad, 2006).

The purpose of this study was to compare direct digital radiographs before and after processing with adaptive histogram equalization in order to detect the effectiveness of this option on diagnostic ability of images in pre apex area.

MATERIALS AND METHODS

This is an experimental labatory study. Twenty eight periapical digital radiographs were selected from digital archive of dental school. The image technology was CCD (Charge Couple Device) recording (Mps.progency USA) with an image matrix of 560×416.8 bites nominal pixel size 72 Mm.

The X-ray tube was planmeca (prostyleintral, Helsinki, Finland) (70 Kvp, 8 mA, 2 mm AL). The image were extracted in uncompressed format (windows R JPEG) The images viewed in laptop: 15 1/4 inch,CRT color monitor (Dell Inspiror W6400). We used Photoshop 8.0 Me.

At first images viewed by expert dental radiologist on monitor. The room was in stable fluorescent lamps. The observer was asked to visually locate the apex of roots in image and fill the questionnaire and grade the quality of examination.

For each root on scale of 1 (condition that the quality of image is very bad and apex not read) to 5 (condition that the quality of image is very good, apex read very good).

At first readers view images single view and studied lamina dura, bone trabeculation, root's apex. They didn't permit to use any changes or processing on the images.

Processing the quality in software is a long terms processing and took long time. In this study, we wanted

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to improve diagnostic value of images without observing images and with histogram increase contrast and decrease noise value of images in short time.

We made histogram more flat. At first, we open the image on Photoshop 8.0 Me then open histogram menu. Then, we open image menu, we selected adjustment and finally brightness and contrast options.

In this study, we move contrast option to right till histogram equalization happened and it made flat and increase contras. Then, processed image and unprocessed image were shown side by side (twin view) and observers asked to fill questionnaire and grade 1-5. So observers studied two times images once single and unprocessed and once twin view and processed.

SPSS sofrware (SPSS Inc., Chicago, IL) were used for data analysis. We used 3 independent observations of image quality for each root apex, we obtained a sample inter observer variance for pereapical readings.

RESULTS AND DISCUSSION

There were 28 pereapial digital images (15 lower jaw, 13 upper jaw), 90 observations root apex, in lower jaw and 117 observations in upper jaw.

Data were analyzed with wilkokson analysis. Diagnostic grade in both upper and lower jaw before and after histogram equalization is different. In first molar in upper jaw the grade of lamina dura and root apex increase by processing, but about bone trabeculation histogram equalization caused decrease the grade (Table 1 and 2).

We found a positive effect of histogram equalization, when we used in twin view reading of preapical images only in molar upper jaw regions. Histogram equalization caused decreased quality of reading bone of trabecualation. It may be because of superimposition of sinus floor.

A previous study found Photoshop soft ware by changing color, light and contrast images caused better images (Caruso and Postel, 2002). Nicopolou-Karayianni *et al.* (2002) found that image processing increased the agreement between the observers.

A previous study found that with using SWAHE (sliding window adaptive histogram equalization) in twin-view in crease the diagnostic quality and enhanced contrast. SWAHE also affects caries diagnosis of bitewing images and further study using a gold standard is warranted (Sund and Moystad, 2006).

Lehmann *et al.* (2002) can perform histogram equalization within an interactively specified Region of Interest (ROI).

Table 1: Meen, median, SD grade in upper jaw molar in different roots

Images	Root	Lamina dura	Bone trabeculation	Root apex
Non-processed	**Palatal**			
	Mean	2.6923	3.6923	2.6923
	Median	3.0000	3.0000	3.0000
	SD	1.0315	0.8548	0.9473
	Distal			
	Mean	2.9231	3.6154	2.9231
	Median	3.0000	4.0000	3.0000
	SD	1.1875	1.1209	0.9540
	Mesial			
	Mean	2.5385	3.4615	3.0000
	Median	3.0000	3.0000	3.0000
	SD	1.3301	0.9674	1.0000
	Total			
	Mean	2.7179	3.5897	2.8718
	Median	3.0000	3.0000	3.0000
	SD	1.1686	0.9656	0.9508
Processed	**Palatal**			
	Mean	3.7692	2.8462	3.9231
	Median	4.0000	3.0000	4.0000
	SD	1.2351	0.6887	0.8623
	Distal			
	Mean	3.3846	2.9231	4.0769
	Median	3.0000	3.0000	4.0000
	SD	0.9607	1.1151	0.7595
	Mesial			
	Mean	3.6923	2.6923	4.0000
	Median	4.0000	3.0000	4.0000
	SD	1.2506	0.6304	0.8165
	Total			
	Mean	3.6154	2.8205	4.0000
	Median	4.0000	3.0000	4.0000
	SD	1.1382	0.8230	0.7947

Table 2: Meen, median, SD grade in mandibule molar in different roots

Images	Root	Lamina dura	Bone trabeculation	Root apex
Non-processed	**Distal**			
	Mean	2.4667	3.0667	3.8000
	Median	2.0000	3.0000	4.0000
	SD	0.8338	0.8837	0.4140
	Mesial			
	Mean	2.4000	3.4000	3.8667
	Median	3.0000	3.0000	4.0000
	SD	1.0556	0.6324	0.7432
	Total			
	Mean	2.4	3.4	3.86
	Median	2.0000	3.0000	4.0000
	SD	1.0556	0.6324	0.7432
Processed	**Distal**			
	Mean	3.6000	3.8667	4.7333
	Median	3.0000	4.0000	5.0000
	SD	0.9102	0.9154	0.4577
	Mesial			
	Mean	3.8000	4.4000	4.9333
	Median	4.0000	5.0000	5.0000
	SD	1.0141	0.8280	0.2582
	Total			
	Mean	3.8	4.4	4.933
	Median	3.5	4.0000	5.0000
	SD	1.0141	0.8280	0.2582

CONCLUSION

Displaying a dental image processed with histogram equalization enhance the subjectively image quality and

providing better information for dentist and facilitate the discerning of root apex in pereapical images and study lamina dura more the computer processing time is not so long and allows this method used routinely in dentistry.

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