

Tolerance limit value of brightness and contrast adjustment on digitized radiographs

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Abstract. The aim of this study was to measure the tolerance limit value of brightness and contrast adjustment on digitized radiograph with apical periodontitis and early apical abscess. Brightness and contrast adjustment on 60 periapical radiograph with apical periodontitis and early apical abscess made by 2 observers. Reliabilities tested by Cohen's Kappa Coefficient and significance tested by wilcoxon test. Tolerance limit value of brightness and contrast adjustment for apical periodontitis is -5 and +5, early apical abscess is -10 and +10, and both is -5 and +5. Brightness and contrast adjustment which not appropriate can alter the evaluation and differential diagnosis of periapical lesion.

1. Introduction

Radiology plays a major role in dentistry. Radiology in dentistry is used as a follow-up examination to assist dentists in examining and diagnosing cases that cannot be seen clinically. In addition, dental radiology is also used to determine appropriate treatment plans and to evaluate treatment outcomes [1-3].

In general, dental radiology is divided into two, namely conventional and digital. Digital radiographs have been recommended in some areas of dentistry because they have advantages over conventional radiographs, which they have the ability to manipulate images (contrast and brightness) and can be viewed directly on a computer monitor [2,4] However, the common radiographic examination used in dentistry today is conventional radiographs. To get the advantages that is possessed by digital radiographs, conventional radiographs need to be transformed into a digitize form in order to make image enhancement arrangements in the form of contrast and brightness. Adjustment and manipulation of radiographic images can add information for diagnostic interpretation [5-6]. The spatial resolution of the human eye depends on the brightness and contrast; therefore many observers use the brightness and contrast features [7-8]. In addition, brightness and contrast are the most effective tools for detecting periapical lesions [7].

One of the purposes of radiological examination is to examine the pulpoperiapical lesions. Pulpoperiapical lesions are lesions that occur due to localized responses to the bone around the apex of the teeth as a result of pulp necrosis or through periapical tissue damage by severe periodontal disease. Based on its severity process, pulpoperiapical lesions are divided into acute apical periodontitis, chronic apical periodontitis, early abscess, periapical abscess, periapical granuloma, and radicular cyst [9-10]. This study focused on lesions of apical periodontitis and early abscess. Radiographically, apical



periodontitis shows a widening radiolucency of pathological periodontal ligament space and unbroken lamina dura, whereas in early abscess lamina dura has been disconnected [10]. Pulpoperiapical lesions require a radiographic examination as a follow-up examination to show a pulpoperiapical state that cannot be seen clinically. In accordance with its location, the correct projection is a periapical intraoral projection [11]. Good-quality radiographs are needed to diagnose pulpoperiapical lesions [9-10].

Research on the effect of image enhancement on the diagnostic accuracy of pulpoperiapical lesions has been done by Jin-Woo Choi *et al.* [12]. The study suggests that image enhancement may affect the quality of periapical radiographs, thereby increasing diagnostic accuracy in pulpoperiapical lesions. However, in cases of periodontal bone loss, adjustment of image enhancement does not indicate an increase in diagnostic accuracy [12].

Currently the brightness and contrast adjustment are based solely on the operator's subjective assessment, not yet objectively defined numbers. Research on boundary values of brightness and contrast adjustment is also limited [13]. This causes each individual to have a different perception in assessing the quality of the radiograph. In addition, the brightness and contrast settings do not always produce a good picture, because incorrect brightness and contrast will result in the wrong diagnosis [12]. Therefore, it is important to note the limiting values of brightness and contrast adjustment to minimize the occurrence of radiographic interpretation errors. In this study, researchers will determine the tolerance limit values of brightness and contrast adjustment to add diagnostic information. The tolerance limit values of brightness and contrast adjustment are not expected to alter diagnostic information and do not eliminate the normal structure picture.

2. Materials and Methods

The research is a cross-sectional study that is descriptive-analytic. The study was conducted in Faculty of Dentistry Universitas Indonesia. The sample of the study amounted to 60 periapical intraoral radiographs taken from the patient's medical record in the radiology department. All radiographs met the inclusion criteria set by the study. The selected radiograph should meet the inclusion criteria. Next quality evaluation on the periapical intraoral radiograph and conversion of the periapical intraoral radiograph into a digitized scan by UMAX Power Look 1120 scanner were performed. After that, the researchers adjust the brightness and contrast values on the digitized radiograph using the adobe photoshop CS program 4. Adjustment of the brightness and contrast value are performed by increasing and decreasing the values by 5 (-15, -10, -5, + 5, + 10, + 15) intervals. Boundary values of brightness and contrast adjustment are obtained when the image begins to undergo radiographic image change. The evaluation of the radiograph after the contrast and brightness changes was done by two observers i.e. researchers and dental students who have completed the dental radiology competence. Observations were made twice at different times. Interpretation of the digitized radiographs that have been done brightness and contrast adjustment based on the evaluation of pulpoperiapikal seven clues was performed.

Data analysis was performed using statistical software. Intraobserver and interobserver reliability tests were performed using Coefficient Cohen's Kappa. If the value of kappa is > 0.61 then between two observations and between two observers indicates the level of assessment

3. Results and Discussion

3.1 Results

To determine the data collected are normally distributed or taken from the normal population can use the normality statistical test. Observation data showed p-value of 0.000 means that the distribution of both groups of data is not normal, then the test used is non parametric test [14]. Analysis of wilcoxon test showed significant difference between before brightness and contrast adjustment with after brightness and contrast adjustment. (*p-value* < 0.05) [14].

Table 1. Brightness and contrast adjustment that begin to experience changes in radiographic features on the diagnosis of apical periodontitis

	Frequency	Total	%	p-value	
Brightness	Lower Brightness	-5	10	33.3	0.002
		-10	29	96.7	0.000
		-15	30	100	0.000
	Upper Brightness	+5	8	26.7	0.005
		+10	29	96.7	0.000
		+15	30	100	0.000
Contrast	Lower Contrast	-5	4	13.3	0.046
		-10	26	86.7	0.000
		-15	30	100	0.000
	Upper Contrast	+5	5	16.7	0.025
		+10	27	90	0.000
		+15	30	100	0.000

Table 2. Brightness and contrast adjustment that begin to experience changes in radiographic features on the diagnosis of early apical abscess

	Frequency	Total	%	p-value	
Brightness	Lower Brightness	-5	3	10	0.083
		-10	22	73.3	0.000
		-15	30	100	0.000
	Upper Brightness	+5	2	6.7	0.157
		+10	20	66.7	0.000
		+15	30	100	0.000
Contrast	Lower Contrast	-5	3	10	0.083
		-10	19	63.3	0.000
		-15	30	100	0.000
	Upper Contrast	+5	3	10	0.083
		+10	17	56.7	0.000
		+15	30	100	0.000

Table 3. Brightness and contrast adjustment that begin to experience changes in radiographic features on the diagnosis of apical periodontitis and early abscess

	Frequency	Total	%	p-value	
Brightness	Lower Brightness	-5	13	21.7	0.000
		-10	51	85	0.000
		-15	60	100	0.000
	Upper Brightness	+5	10	16.7	0.002
		+10	49	81.7	0.000
		+15	60	100	0.000
Contrast	Lower Contrast	-5	7	11.7	0.008
		-10	45	75	0.000
		-15	60	100	0.000
	Upper Contrast	+5	8	13.3	0.005
		+10	44	73.3	0.000

	+15	60	100	0.000
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3.2 Discussion

This study was conducted to determine the tolerance limit values of brightness and contrast adjustment on digitized radiographs. The region of interest (ROI) used is the tooth element with apical periodontitis lesion and early apical abscesses. Reliability test is using Cohen's Kappa coefficient, intraobserver reliability obtained is 0.827 and interobserver reliability is 0.843, meaning intraobserver reliability and interobserver reliability reach almost perfect agreement. Based on statistical test results using wilcoxon test, it can be seen that the radiograph with the diagnosis of apical periodontitis undergoes a radiographic picture change when the brightness and contrast are adjusted starting from -5 for the lower limit and +5 for the upper limit (p-value <0, 05). Unlike the case with radiographs with early abscess diagnoses (Table 2), radiographic image changes begin to occur when the brightness and contrast are adjusted at -10 and +10 (p value <0.05). In table 3 the researchers conducted a descriptive analysis and significance test on apical periodontitis combined with early abscess. Known changes in radiographic images occur when done brightness and contrast settings on the -5 and +5 (p-value <0.05).

The three tables show that radiographs with a diagnosis of apical periodontitis and early apical abscess, as well as apical periodontitis combined with early apical abscesses undergo change in different values of brightness and contrast adjustment. This is because the value of brightness and contrast adjustment depends on the diagnosis under study [12]. Small lesions will be more sensitive if done brightness and contrast adjustment. On the radiograph with the diagnosis of apical periodontitis was observed the width of the periodontal ligament space and the integrity of the lamina dura.¹⁰ Lamina dura structure is thin so that when done the brightness and contrast adjustment with small values (-5 and +5) has caused changes in radiographic images. Furthermore, the brightness and contrast adjustment of early apical abscesses are -10 and +10 because in this lesion the lamina dura is discontinued so that the brightness and contrast control tolerance is required to change the radiographic image larger. Then on a radiograph with a diagnosis of apical periodontitis combined with an early apical abscess begins to undergo a radiographic change in values of -5 and +5 because apical periodontitis begins to change at that value, so that when the number of samples is added in the statistical test, the arrangement at -5 values and +5 started to show different meaningful values.

A similar study was conducted by Jin-Woo Choi *et al.* This study found an effective processing technique to improve the quality of radiographs in periapical lesions is a technique with slightly high contrast [12]. Researchers do not inform the value of contrast at slightly high level. The sample used is direct digital radiograph, therefore the research results are different from this research. Similar research using direct digital radiograph was also performed by Guneri *et al.* [13]. This study found the limits of brightness and contrast adjustment that can change the originality of MG (Mean Gray Value) of a radiograph. This study found the limit value of contrast adjustment that do not change the originality of is +50. In other words, a contrast increase of up to +50 does not distort the authenticity of radiodensitometric data, whereas if the contrast is increased beyond that limit value, the originality of the image can be significantly lost. Unlike the case with increased brightness, Guneri *et al.* revealed the increase in brightness does not affect the originality of MG [13]. This is because all pixels move in the same direction (toward white or black) when the brightness is changed, so the distance between the original and the resultant is the same. On increasing contrast all pixel values stretch so dark areas get darker and brighter areas brighter, so the MG of each pixel will change. The result of this research is different with our research because Guneri *et al.* study did not pay attention to the radiographic image changes that happened when the brightness and contrast adjustment on radiograph.

In this study, we get the limit value of brightness and contrast adjustment that begin to change the radiographic image of a lesion. This limit value can be used to minimize the occurrence of misdiagnostic. The value of brightness and contrast adjustment that is too high can cause changes in the evaluation of pulpoperiapikal lesions and differential diagnosis pulpoperiapikal lesions [14,15]. The weakness of this study is the use of secondary data as a sample because of the limited number of samples available, so that the x-ray conditions and the washing process radiograph is not conditioned despite having a good quality evaluation. The sample studied was not divided based on the region because the number of

samples not distributed equally in each region, so it is not known whether there is a significant difference in each region that has different density and bone thickness.

4. Conclusion

The tolerance of boundary values of brightness and contrast adjustment in apical periodontitis lesion is -5 and +5, whereas in early apical abscesses are -10 and +10. In general, the tolerance limit values of brightness and contrast adjustment for apical periodontitis lesion and early apical abscess are -5 and +5. The adjustment of brightness and contrast between these boundary values is expected to increase diagnostic information without altering the diagnostic interpretation of apical periodontitis lesion and early apical abscesses.

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