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RADIOGRAPHIC EVALUATION OF PERIODONTAL TISSUE DETECTED IN CONE BEAM CT IMAGES FOR TEETH WITH AND WITHOUT APICAL PERIODONTITIS A RETROSPECTIVE STUDY

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ABSTRACT

Aim of the study: The aim of the present work was to evaluate the alveolar bone level and periodontal ligament space thickness of teeth that have apical periodontitis and compare it with teeth without apical periodontitis using cone beam CT images.

Materials & Methods: The study design was a retrospective cross sectional epidemiological study for evaluation of periodontal tissue of 100 teeth using cone beam CT images. The sample consisted of CBCT images of the maxillofacial region from database of 50 patients which were selected from Riyadh Colleges of Dentistry and Pharmacy. The 100 CBCT images were analyzed for the following variables 1-Periodontal ligament space of buccal surfaces at 3 sites cervical, middle and apical third. 2- Periodontal ligament space of lingual surfaces at 3 sites cervical, middle and apical third. 3-Alveolar bone level: the distance from CEJ to the crest of alveolar bone mesially and distally. These variables were detected on teeth with periapical periodontitis and compared with same teeth in the contralateral side of the same arch.

Results: The buccal and lingual periodontal ligament space thickness in cervical, middle, and apical third of teeth with periapical lesion was statistically significant higher than the contra lateral teeth without periapical lesion of the same arch ($p<0.05$). Furthermore, the alveolar bone measures from CEJ to alveolar crest in both mesial and distal sides of the teeth with periapical lesion was statistically significant higher than the contralateral teeth without periapical lesion of the same arch ($p<0.05$).

Conclusions: The present study showed that, periapical infection has negative effects on alveolar bone level and periodontal ligament space thickness. CBCT is an effective diagnostic method to visualize and measure the periodontal ligament space and alveolar bone level.

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INTRODUCTION

Periodontitis consist of a different condition of the periodontal structures that include gingiva, periodontal ligament, cementum and alveolar bone. gingiva and periodontal ligament are soft whereas cementum and alveolar bone are hard structures. [1] Periodontal infection is a common disease that leads to loss of attachment and destruction of alveolar bone. Generally, for periodontal diagnosis clinical signs and symptoms of the diseases were examined. whereas, in the case of periodontal bone loss, radiographs considered a valuable diagnostic tool with the clinical examination. [2,3] Apical periodontitis has negative effect in the periodontal inflammation and in the prevention of periodontal tissue repair. Apical periodontitis is considered as one of the major source of gram negative pathogenic microorganisms that harm the periodontal tissues and lead to periodontal damage that spread from apical region to gingiva and classified as retrograde periodontitis, that differentiate the infection spreads from marginal periodontitis.[4] In the past examination of periodontal structures depends mainly on the conventional two-dimensional imaging modalities as conventional radiography and digital radiography.[5] Whereas, although these facilities are useful and have less radiation exposure, they cannot asses the three-dimensional (3D) nature of periodontal osseous defects.[6] So, radiographic tool that could give an undistorted three dimensional images of a tooth and periodontium is essential to increase the diagnostic accuracy.[7] Recently, cone-beam CT (CBCT) was introduced for acquiring the three dimensional images of oral structures is now available.[8] Cone-beam computed tomography (CBCT) facilitate the shift of dental radiography from diagnosis to image guidance throughout the treatment phase. These modalities improve the precision, decrease the doses, and lesser costs when compared with medical fan-beam CT. [9] The aim of the present study was to evaluate the alveolar bone level and periodontal ligament space thickness of teeth that have apical periodontitis and compare it with teeth without apical periodontitis using cone beam CT images.

MATERIALS AND METHODS

The study design was a retrospective cross sectional epidemiological study for evaluation of periodontal tissue of 100 teeth using cone beam CT images. The samples consisted of CBCT images of the maxillofacial region from database of 50 patients which were selected from Riyadh Colleges of Dentistry and Pharmacy.

Inclusion criteria: The CBCT images of 50 patients showing teeth affected by apical periodontitis and the contralateral teeth without periapical lesion at the same view.

Exclusion criteria: Evidence of trauma, bony fracture, unerupted teeth, and deciduous teeth and if the periodontal tissue could not be identified on all the multiplanar view (axial, sagittal and coronal). The CBCT scans where the apices of teeth are not visible.

Radiographic assessment: The 100 CBCT images of 50 patients were analyzed by Galileos 3D software (Sirona, Germany),. Axial, coronal and sagittal two-dimensional section images were displayed on computer monitor for measurements of the following variables; 1. Periodontal ligament space of buccal surfaces at 3 sites cervical, middle and apical third. 2. Periodontal ligament space of lingual surfaces at 3 sites cervical, middle and apical third. 3. Alveolar bone level: the distance from CEJ to the crest of alveolar bone mesially and distally.

Statistic Analysis:

Descriptive analysis were analyzed by using Mann–Whitney U test (non-parametric) for bone level and periodontal ligament space (PDLS) of teeth affected by apical periodontitis and the contra lateral teeth without periapical lesion of the same arch.

RESULTS

Descriptive analysis of all previous variables was done for 50 teeth affected by apical periodontitis and the contra lateral 50 teeth without periapical lesion of the same patient. This is to compare the periodontal tissue of teeth that have apical periodontitis with the periodontium of healthy teeth using cone beam CT images.

Univariate analysis

Periodontal ligament space thickness

Table 1 and figure 1 shows the descriptive analysis of buccal periodontal ligament space thickness in cervical, middle, and apical parts of teeth not affected by periapical lesion and the contralateral teeth with periapical lesion of the same arch. The highest mean (±SD) of buccal periodontal ligament space thickness was in apical part of teeth with periapical lesion (0.872±0.191 mm) and least in middle part of teeth without periapical lesion (0.489±0.160mm).

Table 2 and figure 2 shows the descriptive analysis of lingual periodontal ligament space thickness in cervical, middle, and apical parts of teeth not affected by periapical lesion and the contralateral teeth with periapical lesion of the same arch. The highest mean (±SD) of lingual periodontal ligament space thickness was in apical part of teeth with periapical lesion (0.890±0.181 mm) and least in middle part of teeth without periapical lesion (0.474±0.132 mm).

Alveolar bone level : Descriptive analysis of mesial and distal sides of alveolar bone level of teeth affected by apical periodontitis and the contra lateral teeth without periapical lesion of the same arch are shown in table 3 and figure 3. The highest mean (±SD) of alveolar bone level in relation

TABLE (1) Descriptive analysis of buccal periodontal ligament space thickness (mm) for teeth with and without periapical radiolucency:

		Mean	Std. Deviation	Median	Range	Minimum	Maximum
Cervical	*No periapical lesion*	0.510	0.163	0.470	0.85	0.27	1.12
	Periapical radiolucency	0.830	0.313	0.775	1.94	0.45	2.39
Middle	*No periapical lesion*	0.489	0.160	0.470	0.79	0.23	1.02
	Periapical radiolucency	0.787	0.210	0.755	1.05	0.44	1.49
Apical	*No periapical lesion*	0.517	0.136	0.490	0.78	0.26	1.04
	Periapical radiolucency	0.872	0.191	0.840	0.90	0.55	1.45

TABLE (2) Descriptive analysis of lingual periodontal ligament space thickness (mm) for teeth with and without periapical radiolucency:

		Mean	Std. Deviation	Median	Range	Minimum	Maximum
Cervical	*No periapical lesion*	0.499	0.138	0.475	0.60	0.27	0.87
	Periapical radiolucency	0.786	0.186	0.775	0.84	0.40	1.24
Middle	*No periapical lesion*	0.474	0.132	0.460	0.71	0.21	0.92
	Periapical radiolucency	0.797	0.16807	0.780	0.87	0.43	1.30
Apical	*No periapical lesion*	0.506	0.159	0.480	0.97	0.28	1.25
	Periapical radiolucency	0.890	0.181	0.880	0.81	0.57	1.38

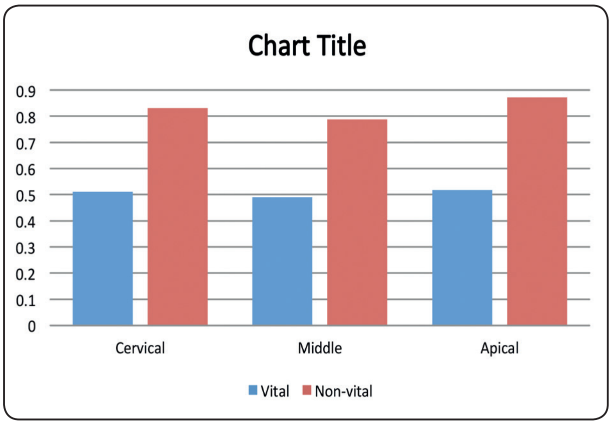

Fig. (1) Mean of buccal periodontal ligament space thickness (mm) for teeth with (orange columns) and without periapical radiolucency (blue columns).

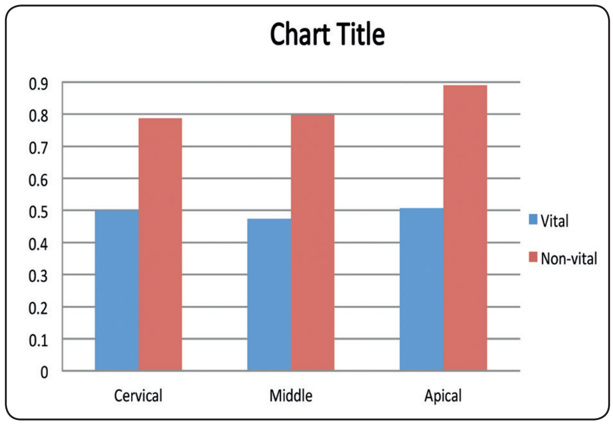

Fig. (2) Mean of lingual periodontal ligament space thickness (mm) for teeth with (orange columns) and without periapical radiolucency (blue columns).

to cemento-enamel junction (CEJ) was in distal side of teeth affected by periapical radiolucency (2.679±0.687) and least in mesial side of teeth without any periapical lesion (1.587±0.553).

Bivariate analysis: The buccal and lingual periodontal ligament space thickness in cervical, middle, and apical parts of teeth with periapical lesion was statistically significant higher than the contra lateral teeth without periapical lesion of the same arch ($p<0.05$). The alveolar bone measures from CEJ to alveolar crest in both mesial and distal sides of teeth with periapical lesion was statistically significant higher than the contra lateral teeth without periapical lesion of the same arch ($p<0.05$). Table 4 shows the results of statistical analysis of alveolar bone level and periodontal ligament space thickness.

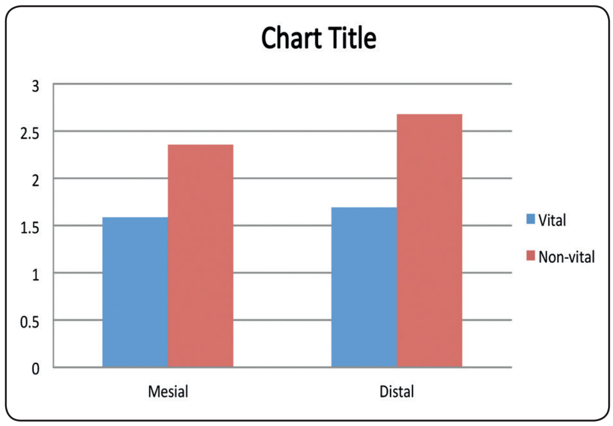

Fig. (3) Mean of alveolar bone level measured from CEJ to alveolar crest of teeth with (orange columns) and without periapical radiolucency (blue columns).

TABLE (3) Descriptive analysis of alveolar bone level in mesial and distal sides measured from CEJ to alveolar crest.

		Mean	**Std. Deviation**	**Median**	**Range**	**Minimum**	**Maximum**
Mesial	*No periapical lesion*	1.587	0.553	1.57	2.87	0.00	2.87
	Periapical radiolucency	2.356	0.630	2.24	2.74	1.26	4.00
Distal	*No periapical lesion*	1.692	0.455	1.65	2.37	0.25	2.62
	Periapical radiolucency	2.679	0.687	2.525	3.67	1.42	5.09

TABLE (4) Statistical analysis of alveolar bone level and periodontal ligament space thickness.

			Mean rank	p value
Alveolar bone level	Mesial	No periapical lesion	33.62	<0.05*
		Periapical radiolucency	67.38	
	Distal	No periapical lesion	30.25	<0.05*
		Periapical radiolucency	70.75	
Periodontal ligament space thickness (Buccal)	Cervical	No periapical lesion	30.47	<0.05*
		Periapical radiolucency	70.53	
	Middle	No periapical lesion	30.10	<0.05*
		Periapical radiolucency	70.90	
	Apical	No periapical lesion	27.71	<0.05*
		Periapical radiolucency	73.29	
Periodontal ligament space thickness (Lingual)	Cervical	No periapical lesion	30.62	<0.05*
		Periapical radiolucency	70.38	
	Middle	No periapical lesion	28.47	<0.05*
		Periapical radiolucency	72.53	
	Apical	No periapical lesion	27.69	<0.05*
		Periapical radiolucency	73.31	

DISCUSSION

This study was a trial to describe the relationship between periodontal and pulpal regions. We have attempted to discuss how the two tissues form a continuum and how pulpal infection contribute upon the periodontal infection. Our results showed that there are a statistically significant differences at all variables (alveolar bone level and periodontal ligament space thickness) between teeth with periapical periodontitis and teeth without periapical periodontitis. This indicates that periapical infection has negative effect on periodontal ligament space thickness and alveolar bone level. It is known that both the pulp and the periodontium are closely related to each other, through the apical foramen, accessory canals, and dentinal tubules of the root, and one can interfere on the integrity of the other.[10] Radiographic assessment of the images, with conventional two-dimensional structure is hard to identify a three-dimensional lesion.[11] Fleiner et al. 2013 investigated the periodontal bone level using CBCT images. They concluded that the CBCT would allow an accurate assessment of bone levels and description of infra-bony defects, craters and furcations.[12] Our results confirmed that the CBCT has excellent diagnostic performance for detection of PDL thickness and alveolar bone level. Although the CBCT images were superior in diagnostic efficacy to conventional intraoral imaging, CBCT images should not necessarily replace intra-oral radiographs. From the standpoint of radiation risk, CBCT appears to have three to seven times the risk of a panoramic images[13]

LIMITATION

The limitations are a limited sample size and a single center study

CONCLUSIONS

The present study showed that, periapical infection has negative effects on alveolar bone level and periodontal ligament space thickness. CBCT has higher sensitivity and diagnostic accuracy for detecting various periodontal defects among the other radiographic modalities. CBCT is an effective diagnostic method to visualize and measure periodontal ligament space and alveolar bone level.

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