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RESEARCH ARTICLE

COMPARISON OF DIAGNOSTIC ACCURACY OF CONVENTIONAL RADIOGRAPHY AND ORTHO-PANTOMOGRAPH IN DETECTION OF PERIAPICAL LESION

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ABSTRACT

Aims and objective: Comparison of diagnostic accuracy of conventional radiography and orthopantomograph in detection of periapical lesion. **Materials and Methods**: The study groups comprised of 150 patients of either sex between age group of 20-60 year reported to the Department of Oral Medicine and Radiology. The determination of 'true pathology' was based on the results of the simultaneous interpretation of both the periapical and the panoramic radiographs in standard. **Results**: The intra-observer reliability analysis is done to measure the consistency in rating method of the observer. It was observed that with Kappa value in range of 0.6 to 0.8, the observation at two different time are significantly agreement. The detailed statistical analysis very clearly indicates that the rating given based on observation from periapical radiograph is better than the observation from panoramic radiograph. The Pearson's R coefficient, Spearman Correlation, Kappa value and Cronbach's Alpha values for periapical radiograph are 0.714, 0.696, 0.436 and 0.833 which are significantly higher than that obtained from observation of panoramic radiograph with values 0.541, 0.604, 0.375 and 0.702 within statistical significance level. The diagnostic accuracy was evaluated with ROC analysis technique. The graph generated by the ROC curve is used to calculate the area under the curve obtained from each imaging technique. The ROC curve and area under each respective plot clearly indicate that the periapical radiography technique is better in diagnosis of lesions. **Conclusion**: the periapical radiographs provides more accuracy in terms of diagnosing the periapical lesion, which provides better diagnostic values as compared to the panoramic images.

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INTRODUCTION

Conventional radiographs traditionally form the backbone n diagnosis, treatment procedures studies comparing periapical and panoramic radiography for the assessment of periapical pathology. The most commonly diagnosed pathos's of odontogenic origin in human teeth are the periapical lesions (Parihar, ?; Bornstein et al., 2015; Rohlin, 1991). These are generally described as apical periodontitis which is an inflammatory response of periodontium due to bacterial infection of inter canal system The major etiological factor is the presence and their colonization (mainly obligate anaerobes), which a play an important role in spreading of infection inside the canal system which is further highly influenced by endotoxins, enzymes, microbial interaction and modulin, which interferences in host immune system (Schulz, 2009; Juerchott et al., 2018). Bacteria's gets colonized inside the canal and start releasing humoral antibodies, & several intercellular mediators in the periradicular tissues which is characterized by bone resorption resulting in the visibility of hypodense area when seen radiographically, due to extra radicular infection. Due to absence of blood supply in the rct of necrotic tooth, which acts as barrier for those microorganisms which are already present inside the pulpal tissues of necrotic

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tooth, from host defense and antibiotics therapy which results into lengthening of the infection inside canal (Juerchott, 2018; Nair, 1996).

Aims and Objectives: Comparison of diagnostic accuracy of conventional radiography and orthopantomograph in detection of periapical lesion

MATERIALS AND METHODS

Study Setting: A study was carried out in the Department of Oral Medicine and Radiology Divya Jyoti College of Dental Sciences and Research Modinagar , Uttar Pradesh.

Study subjects: The study groups comprised of 150 patients of either sex between age group of 20-60 year reported to the Department of Oral Medicine and Radiology .Patients diagnosed by clinical evaluation using the research diagnostic criteria were considered. The patients were informed about the radiographic procedure provided to them and they agreed and signed the consent form (Refer Annexure no. 1).The readings were made with standardized viewing conditions of subdued light. The observer to screen distance was about 60 cm. The determination of 'true pathology' was based on the results of the simultaneous interpretation of both the periapical and the panoramic radiographs in standard condition. The examinee scores the periapical status of the teeth of each patient as follows:

- Definitely no lesion
- Probably no lesion
- Not sure
- Probably a lesion
- Definitely a lesion

In the present study this was accomplished by pooling higher scores as "diseased". The standard diagnosis was made by the examinees based on clinical findings conventional radiographs and digital ortomopantomograph. This standard diagnosis served as gold standard for the study. A set of digital orthopantomograph were presented on laptop monitor and a set of conventional radiograph were kept in transparent sheet to minimize bias that an observer might have towards one type of imaging technique in preference on another. Their diagnoses were done for all the teeth. For the cases where both the radiograph was giving different interpretation, the findings of clinical observation were used to come to a conclusion. The two observations taken in one-week time has been compared to obtain the inter-observer reliability.

Diagnostic instruments for clinical examaination

- Instrument cloth, Kidney tray, Mouth mirror, Tweezer, Periodontal probe, Sterilized cotton, Metallic Divider, Metallic scale, Head cap
- Mouth mask, sterilized hand gloves
- Dental chair with artificial illumination
- Sterile Patient Drape

Inclusion Criteria

- Patients of either sex, age 20-60 years.
- Patients who are physically, mentally healthy and well oriented with time.
- Carious tooth with tenderness high quality diagnostic radiograph.
- Tooth with fully formed root apices.
- Periapical radiolucency's of either tooth in relation to maxilla or mandible.
- Indicated for root canal treatment, periapical surgery, extraction.

Exclusion Criteria

- Radiographic lesions caused by systemic conditions (hyperparathyroidism, Paget's disease, fibrous dysplasia, multiple myeloma, osteoporosis), or ill-defined radiolucency's.
- Other than odontogenic pain.
- Orthodontic treated tooth.
- Tooth fractures.
- Pregnancy
- Patient under carcinoma treatment.

Armamentarium

- Diagnostic instruments for clinical examination.
- Radiographic Investigation performed using:
- IOPA X-RAY machine (Meditra private limited model-Dent –X)
- Digital OPG (Kodak 8000)

RESULTS

The present study was conducted in the Department of Oral Medicine and Radiology, Divya Jyoti College of Dental Sciences and Research with the aim to "COMPARISON OF DIAGNOSTIC ACCURACY OF CONVENTIONAL RADIOGRAPHY AND ORTHOPANTOMOGRAPH IN DETECTION OF PERIAPICAL LESION". A total of 150 cases (80 males and 70 females) of age group 20-60 years, were included in the study. The observations obtained were compiled and results were successfully analysed. Off the 150 teeth considered, 71 (47.33%) are in maxilla and 79 (52.67%) are in mandible. 64.67% of all the teeth consider for the study are molar (97 in number). The distribution of teeth for all population is presented in Table 1. Graph 1 shows the number of teeth of all type consider in present study. There are 14 incisors in maxilla and 6 in mandible, 8 canines in maxilla and 2 in mandible. 23 numbers of premolar have been also considered in both the arches.

A very detailed cross-tabulation analysis is done to obtain the Pearson Chi-Square, likelihood Ratio, Pearson's R, Spearman Correlation and kappa among the rating based on true Pathology and based on individual observation of radiographs. The cross-tabulation analysis of true pathology vs observation from periapical radiograph is presented Table 5 a to c whereas cross-tabulation analysis of true pathology vs observation from panoramic radiograph is presented Table 6 a to c. The reliability of the observations from periapical radiograph and panoramic radiograph has been also estimated in terms of Cronbach's Alpha and ANOVA with Cochran's Test. Table 7 shows the value of reliability statistics for the observation based on periapical radiograph and panoramic radiograph.

Table 1. Distribution of teeth consider for present study

Type of teeth	Maxilla		Mandible		Overall	
	Number	%	Number	%	Number	%
Incisor	14	9.33	6	4.00	20	13.33
Canine	8	5.33	2	1.33	10	6.67
Premolar	14	9.33	9	6.00	23	15.33
Molar	35	23.33	62	41.33	97	64.67

Table 2(a). Cross Tabulation of the Periapical Radiograph Rating during two observation

		IOPA_Read2					Total
		1	2	3	4	5	
IOPA_Read1	1	11	5	0	0	0	16
	2	2	16	2	0	0	20
	3	0	1	30	3	0	34
	4	0	0	3	34	3	40
	5	0	0	0	2	38	40
Total			13	22	35	39	41

Table 2(b). Chi-Square Tests of the Periapical Radiograph Rating during two observation

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	398.414[a]	16	.000
Likelihood Ratio	328.770	16	.000
Linear-by-Linear Association	143.784	1	.000
N of Valid Cases	150		

a. 13 cells (52.0%) have expected count less than 5. The minimum expected count is 1Table 2 (c) Symmetric Measures of the Periapical Radiograph Rating during two observation

		Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Pearson's R	.969	.011	33.462	.000[c]	
Spearman Correlation	.956	.015	31.571	.000[c]	
Kappa	.768	.043	16.786	.000	
N of Valid Cases	150				

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.

Table 3 (a). Cross Tabulation of the Panoramic Radiograph Rating during two observation

		OPG_Read2					Total
		1	2	3	4	5	
OPG_Read1	1	10	7	0	0	0	17
	2	2	11	3	0	0	16
	3	0	0	29	0	0	29
	4	0	0	5	29	7	41
	5	0	0	0	7	40	47
Total		12	18	37	36	47	150

Table 3 (b) Chi-Square Tests of the Panoramic Radiograph Rating during two observation

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	338.287[a]	16	.000
Likelihood Ratio	297.291	16	.000
Linear-by-Linear Association	131.604	1	.000
N of Valid Cases	150		

a. 13 cells (52.0%) have expected count less than 5. The minimum expected count is 1.28.

Table 3(c) Symmetric Measures of the Panoramic Radiograph Rating during two observation

		Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Interval by Interval	Pearson's R	.940	.011	33.462	.000[c]
Ordinal by Ordinal	Spearman Correlation	.933	.015	31.571	.000[c]
Measure of Agreement	Kappa	.630	.043	16.786	.000
N of Valid Cases		150			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.

Table 4. Frequency Distribution of rating based on true pathology and by observation of radiograph

Rating	Based on True Pathology	Based on observation of periapical radiograph	Based on observation of panoramic radiograph
1	13	15	17
2	16	19	16
3	27	35	29
4	35	42	41
5	59	39	47

Table 5(a). Cross Tabulation of rating based on true pathology and by observation of Periapical radiograph

		True Pathology Rating					Total
		1	2	3	4	5	
Periapical Radiograph Rating	1	10	3	0	1	1	15
	2	1	8	5	3	2	19
	3	1	2	17	11	4	35
	4	1	3	2	17	19	42
	5	0	0	3	3	33	39
Total		13	16	27	35	59	150

Table 5(b) Chi-Square Tests of the rating based on true pathology and by observation of Periapical radiograph

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	165.734[a]	16	.000
Likelihood Ratio	133.908	16	.000
Linear-by-Linear Association	75.904	1	.000
N of Valid Cases	150		

Table 5(c) Symmetric Measures of the of the rating based on true pathology and by observation of Periapical radiograph

		Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Interval by Interval	Pearson's R	.714	.053	12.397	.000[c]
Ordinal by Ordinal	Spearman Correlation	.696	.052	11.794	.000[c]
Measure of Agreement	Kappa	.436	.052	10.159	.000
N of Valid Cases		150			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.

Table 6(a). Cross Tabulation of rating based on true pathology and by observation of panoramic radiograph

		True Pathology Rating					Total
		1	2	3	4	5	
Panoramic Radiograph Rating	1	4	4	4	3	2	17
	2	2	4	7	2	1	16
	3	2	4	12	7	4	29
	4	4	2	2	20	13	41
	5	1	2	2	3	39	47
Total		13	16	27	35	59	

Table 6 (b). Chi-Square Tests of the rating based on true pathology and by observation of panoramic radiograph

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	94.140[a]	16	.000
Likelihood Ratio	92.394	16	.000
Linear-by-Linear Association	43.609	1	.000
N of Valid Cases	150		

a. 13 cells (52.0%) have expected count less than 5. The minimum expected count is 1.39.

Table 6 (c) Symmetric Measures of the of the rating based on true pathology and by observation of panoramic radiograph

		Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Interval by Interval	Pearson's R	.541	.068	7.826	.000[c]
Ordinal by Ordinal	Spearman Correlation	.604	.062	9.210	.000[c]
Measure of Agreement	Kappa	.375	.050	8.545	.000
N of Valid Cases		150			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.

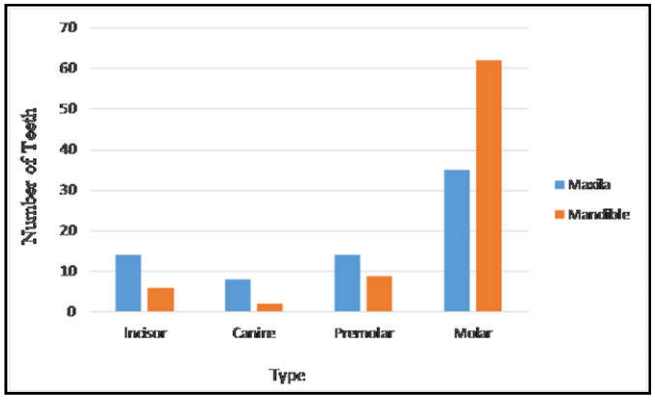
Observation method	Cronbach's Alpha	ANOVA with cochran's test		
		Sum of Squares	Mean Square	Cochran's Q
Based on periapical Radiograph	0.833	428.587	2.876	10.390
Based on panoramic Radiograph	0.702	401.947	2.698	2.770

Table 8. Area under the ROC curve obtained for individual imaging technique

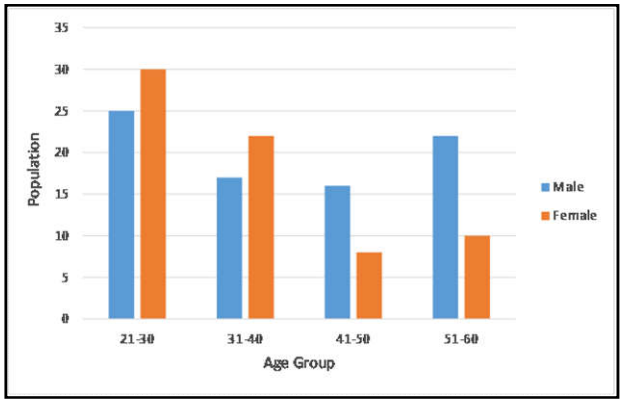
Test Result Variable(s)	Area Under the Curve	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
PRI_IOPA	.845	.033	.000	.780	.911
PRI_OPG	.738	.035	.000	.769	.906

The test result variable(s): PRI_IOPA, PRI_OPG has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.
a. Under the nonparametric assumption
b. Null hypothesis: true area = 0.5

The receiver operating characteristic (ROC) curve is also obtained to measure the value of the probability of accuracy. The value of P (A) i.e. area under the ROC curve where points representing the true-positive fraction (Sensitivity) and 1-false-positive fraction (1-specificity) are plotted on linear probability scales. The P(A) value was calculated for each method of observation.

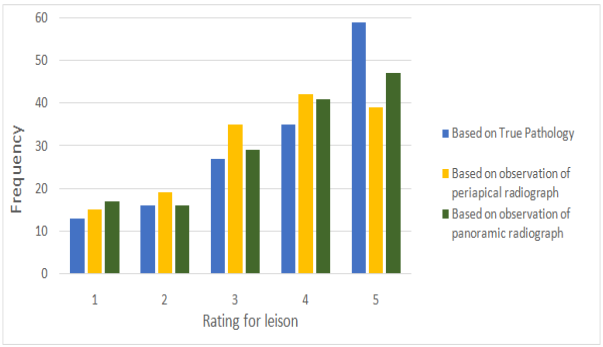


Graph 1. Distribution of the teeth considered in the present study.

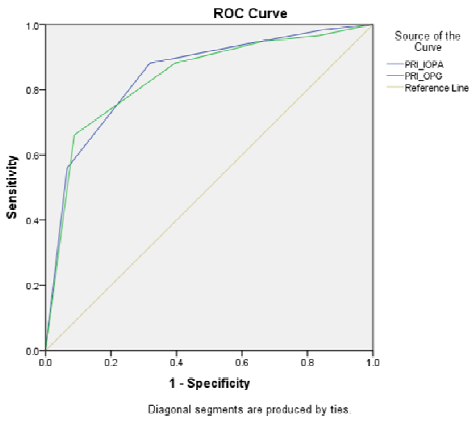


Graph 2. Population distribution of the subjects considered in the present study

Graph 4 represent the ROC curve obtained for each imaging technique. Table 8 shows the area under each ROC curve and associated significance. This study was carried out to compare the use of periapical radiographs and digital panoramic images displayed on monitor in the assessment of the periapical status of the teeth. The periapical status was assessed in term of five ratings given for presence and probability of assessment of lesion.



Graph 4. Frequency distribution of the rating based on true pathology and by observation of radiograph



Graph 5. The ROC curve obtained from rating given for observation of radiograph

The intra-observer reliability analysis is done to measure the consistency in rating method of the observer. It was observed that with Kappa value in range of 0.6 to 0.8, the observation at two different time are significantly agreement. The detailed statistical analysis very clearly indicates that the rating given based on observation from periapical radiograph is better than the observation from panoramic radiograph. The Pearson's R coefficient, Spearman Correlation, Kappa value and Cronbach's Alpha values for periapical radiograph are 0.714, 0.696, 0.436 and 0.833 which are significantly higher than that obtained from observation of panoramic radiograph with values 0.541, 0.604, 0.375 and 0.702 within statistical significance level. The diagnostic accuracy was evaluated with ROC analysis technique. The graph generated by the ROC curve is used to calculate the area under the curve obtained from each imaging technique. The ROC curve and area under each respective plot clearly indicate that the periapical radiography technique is better in diagnosis of lesions.

DISSCUSSION

The present study determined the percentage of correct diagnosis, sensitivity, specificity and the reliability of periapical radiographic diagnosis of periapical lesions through periapical and panoramic techniques the results were according to Yokotal et al Although here used the same criteria and similar scoring procedure, the intra-observer agreement for periapical radiography done. Most of the changes between the first and second readings for the latter consisted of a change of score 1 to score 2 or vice versa. A decision to score 1 (definitely no lesion) is highly influenced by the assessment of the continuity and shape of the lamina dura. This process can be compared with feature analysis, a structural analysis based on certain features being present at certain positions": In panoramic radiographs, however, the lamina dura is not always well defined, even though the surrounding bone is of normal density, and this ambiguity evidently influenced the consistency of the observer.According to the periapical radiographs was more accurate in identifying lesions as compare to panaromic radiographs. The results of our study support most of the in vitro studies regarding specificity and sensitivity (Yokota, 1994). Off the 150 teeth considered, 71 (47.33%) are in maxilla and 79 (52.67%) are in mandible. 64.67% of all the teeth consider for the study are molar (97 in number). The distribution of teeth for all population is presented in Table 5.1. Figure 5.2 shows the number of teeth of all type consider in present study. There are 14 incisors in maxilla and 6 in mandible, 8 canines in maxilla and 2 in mandible. 23 numbers of premolar have been also considered in both the arches. The periapical and panoramic radiographs with satisfactory quality of 150 subjects (80 male and 70 females ranging from 20 to 60 years with a mean of 37.88 ± 20.17 years) were included in the study. With regard to overall comparison of between intraoral periapical radiographs and orthopantomograms, showed that intraoral periapical radiographs has the higher percentage compared to orthopantomogram. The intra-observer reliability analysis is done to measure the consistency in rating method of the observer. It was observed that with Kappa value in range of 0.6 to 0.8, the observation at two different time are significantly agreement. The detailed statistical analysis very clearly indicates that the rating given based on observation from periapical radiograph is better than the observation from panoramic radiograph. The Pearson's R coefficient, Spearman Correlation, Kappa value and Cronbach's Alpha values for periapical radiograph are 0.714, 0.696, 0.436 and 0.833 which are significantly higher than that obtained from observation of panoramic radiograph with values 0.541, 0.604, 0.375 and 0.702 within statistical significance level. The diagnostic accuracy was evaluated with ROC analysis technique. The graph generated by the ROC curve is used to calculate the area under the curve obtained from each imaging technique. The ROC curve and area under each respective plot clearly indicate that the periapical radiography technique is better in diagnosis of lesions. Area under curve for periapical radiographs have 84.5 % were panaromic radiographs shows 73.8%, hence shown that periapical radiographs gives better accuracy than panaromic images. . Similar observation was also observed by previous researchers like Rohlin et al. 1991, Huumonen & Ørstavik 2002 (Rohlin, 1991; Yokota, 1994; Brynolf, 1967; Ørstavik, 2008; Simon, 1980).

Conclusion

Hence on the basis of our study we can conclude that the periapical radiographs provides more accuracy in terms to giving minor changes in the periapical lesion, which provides better diagnostic values as we compare to the panoramic images. Although the panoramic images provides better information in terms of wider spectrum, when there requirement of comparing right with the left side. The magnitude of the methodological error of each radiographic method limits the real changes in disease status. More clinical studies are needed to determine the relative diagnostic efficacy of these imaging modalities', with respect to detection of periapical lesion.

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