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**DIAGNOSTIC ACCURACY OF 2-D IMAGING USING RVG AND OPG AS  
COMPARED TO SURGICAL ACCESS TO PERIODONTAL DEFECT**

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**ABSTRACT**

We live in a world of evidence-based medicine, which requires substantiation of every action or diagnosis established with a certain amount of accountability. The adjunctive use of modern technology and its advancements in the field of diagnostic imaging has evolved over the past few years. These advancements include the judicious use of cone beam computer tomography and ultrasound real time imaging with colour power Doppler. However, all these advances till date cannot be declared as the gold standard as they are either not cost effective or are extremely technique sensitive which means they cannot be applied on a large scale to diagnose periodontal pathologies. Apart from just these drawbacks there are also concerns regarding the dose of radiation exposure while taking an IOPA and an OPG, where OPG is at an advantage being an extra-oral radiation exposure source. With these limitations in mind the rationale behind the present study was to use currently available affordable means of diagnostic imaging in the form of Radio-visual-grams and Ortho-Panto-grams to predict the underlying bone morphology as compared to the gold standard of exploratory surgery of periodontal defects. The results obtained suggest RVG are diagnostically more accurate to capture individual site bone levels as compared to OPG and also portrait a closer picture to the actual Bone defect while the OPG seem to exaggerate the size of the defect extensively depending on the depth of the defect.

**Keywords: RVG, OPG, Periodontal Bone Defects, Bone Morphology**

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**INTRODUCTION**

Dentistry and all its branches has routinely applied and utilised radiographic imaging as a modality to arrive at a diagnosis for past few decades, in Periodontology however it has always been referred to as an adjunct in formulation of a diagnosis. Since their invention by Roentgen on November 8<sup>th</sup>, 1895 and their initial application in Dentistry by Dr. Otto Walkhoff in 1896, they have become a Gold standard to visualise teeth and underlying bone in 2 dimensions. Digital imaging has always gained popularity over conventional imaging for various reasons such as minimal radiation exposure per patient, ability to alter the obtained image in terms of size, contrast, noise reduction, picture enhancements [1, 2]. However even with Image alterations and enhancements comparative studies between conventional intraoral X-rays and RVGS show no significant difference in diagnostic accuracy [3]. One of the major reasons for widespread acceptance of digital radiography is its ability to retain the observers memory and compare it with subsequently viewed images [4]. Studies have been conducted to assess the image quality and accuracy of IOPA and OPG which suggested that RVG produce better imaging quality, however they did not compare it to periodontal surgical site to assess bone defects [5]. The aim of this

study was to assess the diagnostic accuracy of bone morphology using RVG, OPG as compared to surgical exposure of periodontal defects in terms of vertical and horizontal dimensions.

**METHODOLOGY**

The current study was a single university based cohort study where all patients had periodontitis with bone defects. Included patients in the present study were selected by convenience sampling from the periodontology department of a Chennai based dental college, who got treatment done from 1st June 2018 till 1st July 2018. Data was screened by two blinded investigators, where inter examiner agreement was reached prior to inclusion of individuals into the study. The segregation of data was initiated after ethical approval from University scientific review board (SRB/SDMDS11/18/PERIO/12).The present study included patients with generalised/ localised chronic periodontitis, generalised/ localised aggressive periodontitis as per classification of periodontal disease 1999 given by Armitage with bone defects in either vertical (intra-bony defects and angular defect) or horizontal planes (including ledges or horizontal bone defects) on any type of tooth. All individuals included in this study were screened by a single operator while treatment was done by the

same operator supervised by faculty from the department of Periodontology. Detailed case sheets were recorded including periodontal findings such as probing pocket depth, clinical attachment levels measured using William's periodontal probe by Hu friedy, Miller's mobility and Glickman's furcation involvement based on which a diagnosis of localised or generalised chronic periodontitis was formulated.

Individuals excluded from this study were pregnant women, lactating mothers, patients with systemic disease, collagen metabolic disorders, patients with no evidence of bone loss, mesioangular and distoangular bone defects involving the same tooth.

The parameters assessed include presurgical radiographs of selected periodontal bone defects in the form of Ortho pantograms taken using EXTOR-C by Genoray Ltd, as well as site specific intraoral radiographs taken by SatelecPvt. These Radiographs were standardized using sensor beam aiming devices under the guidance of locator rings manufactured by Carestream health, Rochester, New York with acrylic stents for reference permitting probing along 1 line angle for each of the involved teeth. Individual sites taken were assessed in both vertical as well as horizontal plane using the measuring tool of dental imaging software version 6.14.7 in millimetres for both the RVG as well as

OPG without any magnification, rotation or amplification to the obtained radiographs. During Flap surgery, under adequate anesthesia a Kirkland flap was raised, following which debridement was done along with moping of the site using moistened cotton gauze. Williams periodontal probe was inserted through the acrylic template into the desired site till the extent of stable healthy bone margin was seen and stable tactile sensation felt. The defects were then measured either vertically or horizontally using a 150mm/6inch stainless steel digital vernier caliper with an LCD display.

#### **Statistical Analysis**

All values obtained in the present study were analysed using SPSS version 23. (the Statistical Package for the Social Sciences (SPSS) developed by Norman H. Nie, Dale H. Bent, and C. Hadlai Hull) P value less than 0.05 was considered statistically significant. Chi square test was done to assess the association between age, gender and surgical exposure sites measurement which was found to be statistically insignificant. Anova was done which showed intra group measurement values were found to be statistically insignificant while Pearson's correlation coefficient was carried out between measurements made on RVG, as compared to those from surgical site exposure with a positive correlation of 0.819 (**Figure 1**).

While correlation between measurements made on OPG compared to those from surgical site exposure were found to be a positive correlation of 0.695 (**Figure 2**).

## RESULTS

In the present study we observed that a total of thirty patients were included, among these 17 were male patients while 13 were female with a mean age of 42 years (**Table 1**). The mean RVG measurement were found to be  $3.65 \pm 1.55$  mm, while OPG measurements were  $3.5 \pm$

1.49 as compared to surgical exposure which was about  $4.9 \pm 1.93$  mm (**Table 1**).

In the present study we observed that the diagnostic accuracy while comparing 2 D imaging modalities such as RVG and OPG to surgical exposure of periodontal defects showed RVG was more accurate with a higher correlation to surgical exposure of site as compared to OPG. However in periodontal defects which are about 3 mm or so in dimension the diagnostic accuracy of both RVG and OPG appear to be similar.

**Table 1: Measurements obtained from 30 cases from RVG, OPG and surgical exposure of site during the study compared to number of patients in terms of gender, between age groups; Chi square test was used to assess statistical significance between age, gender and exposure to surgical sites both were found to be statistically insignificant with p value >0.05**

Total Number of Patients = 30 (n)	Age (years)	Number of patients (n)	MEAN RVG measurement (mm)	Mean OPG measurements (mm)	Mean surgical exposure measurements (mm)
Males-17					
Females-13	20 to 40	10	4.7	4.2	6
X2 age: surgical exposure measurements (0.208)	40 to 50	14	3.2	2.9	4
	Greater than 60	6	3.1	3.4	4.8
X2 gender: surgical exposure measurements (0.602)					
	TOTAL	30	$3.65 \pm 1.55$	$3.5 \pm 1.49$	$4.9 \pm 1.93$

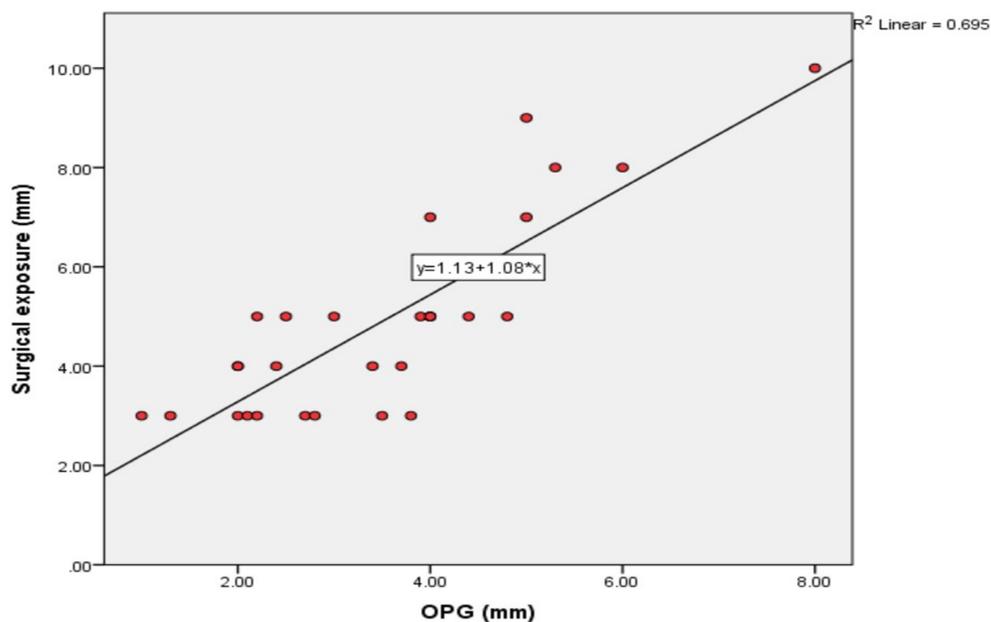


Figure 1: Scatter plot showing relation between measurements obtained from OPG (mm) compared to surgical exposure periodontal site (mm) with Y line=  $1.13 + 1.08 * x$  showing linear correlation of both variables as 0.695 with a p value of  $< 0.05$ , considered statistically significant

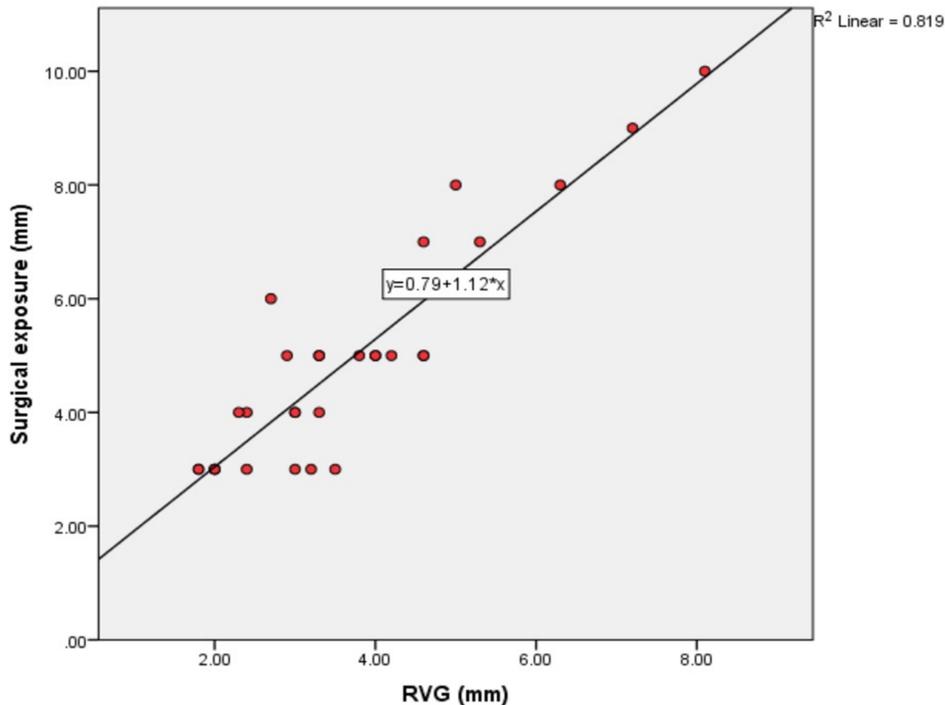


Figure 2: Scatter plot showing relation between measurements obtained from RVG (mm) compared to surgical exposure periodontal site (mm) with Y line=  $0.79 + 1.12 * x$  showing linear correlation of both variables as 0.819 with a p value of  $< 0.05$ , considered statistically significant

## DISCUSSION

We currently live in a world of evidence based Medicine which prefers the use of imaging modalities or investigations to reach a concrete diagnosis rather than exploratory surgery performed to attain the same. In this context, the following study was designed to determine the predictability of bone morphology by noninvasive radiographic imaging namely RVG and OPG as compared to surgical exposure into the periodontal defect.

Studies have been performed comparing different photon detectors used in Digital radiographs such as charge coupled devices, phosphor storage plates and digital sensors, suggesting superior image quality in PSP images, but at the same time some studies also suggest that images obtained by all 3 means were comparable [6, 7]. Thus an assumption was made prior to the initiation of the study that a conventional digital RVG sensor would be used instead of CCD or PSP as it more frequently used in dental clinics. However these studies itself do not consider the width and dimensions of an RVG as possible drawback to image accuracy which is larger than an IOPA suggesting clearer images are obtained with beam positioning devices using the latter.

OPG on the other hand have been known to provide a holistic picture of the patients generalised problems at a glance covering a

larger surface area along with being more comfortable to all patients with an additional advantage in case of certain clinical situations such as constricted mouth opening or accentuated gag reflex or Impacted 3<sup>rd</sup> molars [8, 9]. The 15% enlargement obtained on an OPG is also a well established fact based on previous studies [10].

Based on the above obtained results the following assumptions could be made, RVG are diagnostically more accurate to capture individual site bone levels as compared to OPG. RVG also appear to have a tendency to portrait a closer picture to the actual Bone defect while the OPG always exaggerate or seem to increase the size of the defect extensively. However in case of superficial Bone defects of about 3 mm or so the diagnostic accuracy of both RVG and OPG are similar.

Another observation which could be made is the percentage repeatability or the chance when an RVG or OPG were taken again would portrait similar results as obtained in the first attempt. In case of RVG there are external factors such as magnification or foreshortening which could affect the quality of the image obtained despite the use of Templates to standardise the X-rays [11, 12]. While in case of OPG there is a higher chance of repeatability. These findings when applied along with the convenience provided by

newer handheld portable dental X-ray equipment makes it one of the most commonly used, reliable, affordable diagnostic tools to view bone morphology [13]. However at the same time newer research suggests a possible link between exposure of X-ray treatment to the head and full mouth X-ray series and Thyroid cancer, Meningiomas, parotid tumours [14, 15]. Thus the best method to utilize X-rays apart from the predefined ALARA principles would suggest their use as an adjunct or diagnostic aid only when required to confirm a clinically diagnosis/provisional diagnosis.

Newer and more sophisticated methods of Diagnostic imaging have emerged such as Cone beam computed tomography, Ultrasound real time imaging with colour power doppler to overcome the minor drawbacks of both RVGs and OPGs to capture the entire picture [16].

However despite all these current advances and trends in imaging technologies, till date there are no perfect and cost effective methods to view bone morphology as compared to Exploratory surgery into involved sites. At the same time surgery is highly regarded as a treatment modality while its role as diagnose modality for an underlying pathology has always been frowned upon without sufficient reasoning or justification. Perhaps a Rvg with a replicable stent

located into involved site such as a GP point or a barium screw or Radio-Opaque dyes which can be injected into bone defects to assess and evaluate the size of bone defects and simultaneously evaluate the amount graft-able material required to fill the defect could be a possible futuristic approach with potential for 3-d printing for side by side adequate bone fill material to be synthesised as well.

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