

**Comparative evaluation of accuracy of 2D and 3D methods for evaluating alveolar ridge dimension prior to implant placement: An in vivo study**

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**Abstract**

**Purpose:** To compare the techniques, i.e. ridge mapping, pantomogram and CBCT, which are used to measure the alveolar ridge bone width, and determine their accuracy in the clinical application.

**Methods and Material:**The study was conducted on 30 patients for replacement of missing first molars with dental implant. Width of alveolar ridge was studied by two techniques, i.e. CBCT scan procedure, ridge mapping at two points (3 mm , 6mm from the crest of ridge) and height of alveolar ridge was studied with help of ortho pantomogram and metal ball bearing method, and then taking measurements of CBCT as the control group, the measurements obtained from the other two techniques were compared and then accuracy of these methods were assessed.

**Statistical analysis used:** Student Paired t-Test.

**Results:** Statistically significant differences were obtained with CBCT and OPG measurements ( $P < 0.001$ ). Statistically significant differences were obtained ( $P < 0.001$ ) mean ball diameter between actual and OPG readings. Statistically significant differences were obtained with CBCT and cast measurements ( $P < 0.001$ ) at 3mm and 6 mm from the alveolar crest. There was mean percentage difference of 8.756% between height measured by OPG and CBCT, difference of 8.330% in diameter measured by actual method on ball bearing and OPG, difference of 17.65% and 15.56% in width measured at 3mm and 6mm respectively using actual cast and CBCT.

**Conclusions:** A simple calculation can be used to evaluate the height and width of the alveolar bone using two

dimensional methods i.e; OPG and Cast-based ridge mapping.

**Keywords:** CBCT, OPG, Ridge mapping, Dental implant, Magnification percentage error.

### **Introduction**

Replacement of missing teeth has always been an important issue in dentistry. There are different options to achieve this goal such as removable partial denture, fixed partial denture, and dental implants.<sup>1</sup> Among them, dental implant is reliable choice for the rehabilitation of edentulous spaces.<sup>2</sup> The selection of implant site, size, and angulations is challenging to the clinician, and it is very difficult to meet these challenges without proper dental radiographs of the implant site, both prior and after the placement of implants.

Panoramic radiography is an easy and fast technique to study the images of the upper and lower arches along with their surrounding structures in one view with less radiation exposure than the complete series of intra-oral radiographs. But one of the main problems of this method is magnification of anatomical structures.<sup>3</sup>

CBCT has been demonstrated as a very useful tool in pre-surgical planning, providing high spatial resolution, short scan time and rapid image acquisition. Nevertheless, the additional cost and still the lack of availability in many places of the globe, leads many professionals to use conventional radiography and clinical methods as ridge mapping to make reasonable dental planting using OPG to reduce risks.<sup>4</sup>

Therefore, it is clinically meaningful to determine the magnification percentage of OPG to obtain correct diagnosis. This will allow clinicians to estimate the real bone measurement based on the OPG measurement and the magnification percentage to obtain the ideal implants placement.

### **Subjects and Methods:**

The study was conducted in the Department of Implantology, Vokkaligara Sangha Dental College and Hospital, Bangalore. The inclusion criteria included subjects free from any systemic disease, age group of 19–60 years, and subjects having at least mandibular and maxillary first molar edentulous area. Totally, 30 patients of mandibular and maxillary posterior molar edentulous areas were selected and subjected to clinical examination. Every patient was instructed about the procedures and the nature of the research, and those who agree to participate signed an informed consent. Stone study models were fabricated from alginate impressions for each patient.

### **Fabrication of radiographic stent**

Wax-up of the edentulous molar region was done and a putty index was made. A metal ball was later placed in the same molar region after removal of the wax-up and with help of putty index clear acrylic resin was placed on the molar region with metal ball to fabricate the radiographic stent. The stent obtained was placed in patients' mouth and an OPG was done. Dimensions of the metal ball on the OPG was measured by using digital caliper and compared with actual measurement of metal ball.



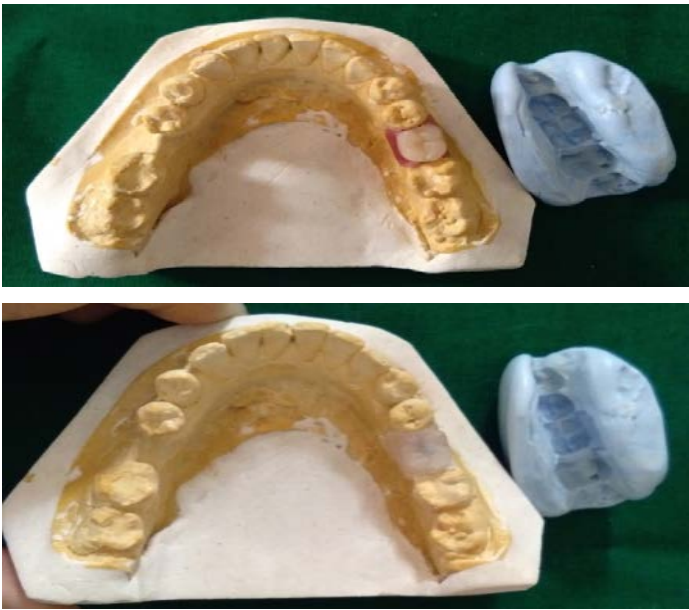


Fig 1: Fabrication of radiographic stent

#### Measurement of alveolar bone width on stone cast

For ridge mapping clear acrylic stent was fabricated. Two pairs of buccal/lingual measurement points were defined at the site for implant placement and marked on the study model. These points, located 3 and 6 mm from the surface of the alveolar soft tissue, were transferred to the stent by drilling 1.0-mm diameter guide holes. Markings at 3 and 6 mm below the alveolar crest were transferred from stone cast to patients' mouth for ridge mapping. Evaluation of mucosal thickness was done by using an endodontic file with rubber stopper. Width of alveolar bone was evaluated by subtracting total soft tissue thickness from total width measured on stone cast.



Fig 2: Measurement of alveolar bone width on stone cast

#### Measurement of metal ball diameter as reference



Fig 3: Measurement of metal ball diameter as reference

**Measurement of metal ball diameter on OPG**

**Measurement of alveolar bone height and width**

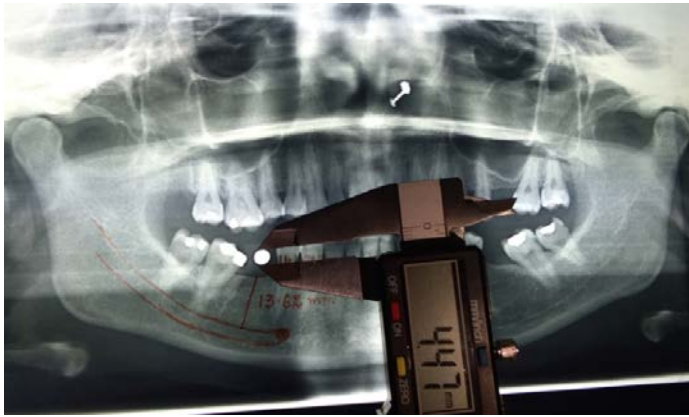


Fig 4: Measurement of metal ball diameter on OPG  
Measurement of alveolar bone height and width was done at 3 and 6 mm below the alveolar crest using CBCT.

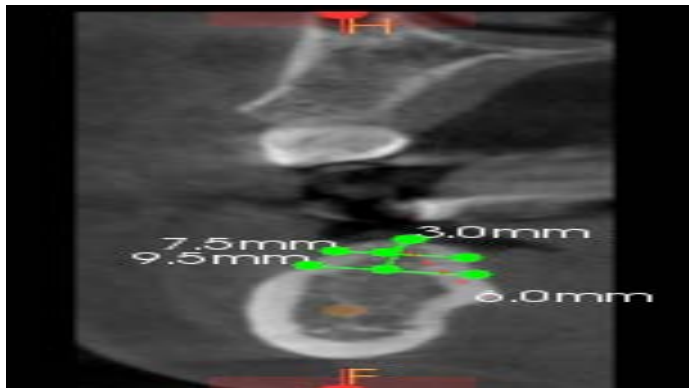
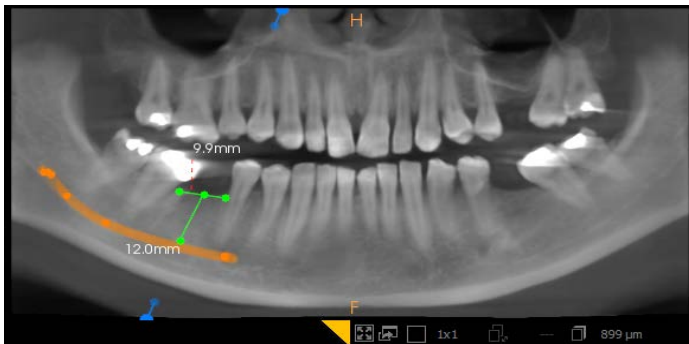


Fig 5: Measurement of alveolar bone height and width using CBCT

**Results**

A total of 30 implants sites were evaluated. Table 1 shows mean alveolar ridge dimensions obtained from the two methods CBCT and OPG. Statistically significant differences were obtained with CBCT and OPG

measurements ( $P < 0.001$ ). Table 2 shows comparison of mean ball diameter between actual and OPG readings. Statistically significant differences were obtained ( $P < 0.001$ ). Table 3 and 4 shows comparison of mean bone width at 3mm and 6 mm from the alveolar crest between cast and CBCT readings. Statistically significant differences were obtained with CBCT and cast measurements ( $P < 0.001$ ). Table 5 shows mean percentage difference of 8.756% between height measured by OPG and CBCT, difference of 8.330% in diameter measured by actual method on ball bearing and OPG, difference of 17.65% and 15.56% in width measured at 3mm and 6mm respectively using actual cast and CBCT.

Table 1

Comparison of mean bone height (in mm) between OPG & CBCT methods using Student Paired t Test							
Methods	N	Mean	SD	Mean Diff	95% CI for the Diff.		P-Value
OPG	30	12.645	2.906	0.95	0.773	1.134	<0.001*
CBCT	30	11.691	2.868				

Table 2

Comparison of mean metal ball diameter (in mm) between actual & OPG readings using Student Paired t Test							
Methods	N	Mean	SD	Mean Diff	95% CI for the Diff.		P-Value
Actual	30	4.820	0.000	0.402	0.356	0.447	<0.001*
OPG	30	4.418	0.123				

Table 3

Comparison of mean bone width (in mm) at 3 mm from the Alveolar crest between CAST & CBCT readings using Student Paired t Test							
Methods	N	Mean	SD	Mean Diff	95% CI for the Diff.		P-Value
CAST	30	7.13	1.19	-1.26	-1.50	-1.02	<0.001*
CBCT	30	8.38	1.49				

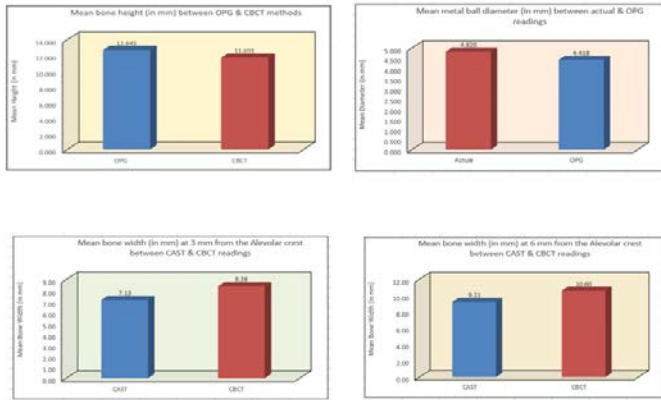
Table 4

Comparison of mean bone width (in mm) 6 mm from the Alveolar crest between CAST & CBCT readings using Student Paired t Test							
Methods	N	Mean	SD	Mean Diff	95% CI for the Diff.		P-Value
CAST	30	9.21	1.81	-1.38	-1.65	-1.12	<0.001*
CBCT	30	10.60	1.84				

Table 5

Mean Percentage difference between different methods for various study variables				
Variables	Mean	SD	Min	Max
Height	8.756	4.820	7.390	20.140
Diameter	8.330	2.546	2.700	12.860
Width 3mm	17.65	8.85	1.67	40.00
Width 6mm	15.56	8.10	2.07	37.78

**Graph**



$$\text{Magnification \%} = \frac{\text{Size of image}}{\text{Actual size of object}}$$

Actual size of object

$$\text{Actual bone height/width} = \frac{\text{Height /width of the alveolar bone on OPG or cast}}{\text{Magnification \% difference}}$$

**Discussion**

In the present study, OPG and cast based ridge-mapping measurements were compared to CBCT image measurements for evaluation of the height and bucco-lingual width of the alveolar ridge respectively. CBCT no doubt seems to be the most accurate measurement.

But despite of various advantages, CBCT include limited availability of reconstructive software, expense, higher doses of radiation. Moreover, lack of understanding of the dentist's imaging needs radiologic technologists and medical radiologists to interpret the CT images Therefore, the reliability of the other two methods, cast based ridge mapping and OPG image measurements can be taken into consideration.

As we got certain mean percentage difference values in this study, we can use those values to measure the actual bone height with the help of simple magnification formula. Measuring the height of alveolar bone on the OPG and width on cast-based ridge mapping and dividing it by the percentage difference obtained in this study. Only in this way we can calculate an accurate measure of bone height and width from the conventional OPG and cast based method.

Direct caliper measurement following surgical exposure of the bone is the most accurate measurement and could be considered the “gold standard”.<sup>5,6</sup> Further Cast-based method used to measure the width of bone can be compared to direct caliper measurement to evaluate the accuracy of the case-based ridge mapping method. This study was conducted using OPG machine (dentsply Sirona orthophos XG, Kv 64, mA 8, exposure time 14.1 s) and CBCT machine (carestream Dental, Kv 90, mA 50, time 0.03) and values obtained cannot be taken as universal values without further studies and validation.

**Conclusion**

A simple method of obtaining quick and accurate measurements of bone height is presented. By using these means the actual bone height can be mathematically evaluated. This method should be considered as an aid in treatment planning for implant restorations and should be associated with ridge cast-based ridge mapping for the decision-making process.

**References**

1. Shahidi S, Zamiri B, Abolvardi M, Akhlaghian M, Paknahad M. Comparison of dental panoramic radiography and CBCT for measuring vertical bone height in different horizontal locations of posterior mandibular alveolar process. Journal of Dentistry. 2018 Jun;19(2):83.
2. Chugh A, Bhisnoi P, Kalra D, Maggu S, Singh V. Comparative evaluation of three different methods for evaluating alveolar ridge dimension prior to implant placement: An in vivo study. Journal of Dental Implants. 2013 Jul 1;3(2):101.

3. Yassaei S, Ezoddini-Ardakani F, Ostovar N. Predicting the actual length of premolar teeth on the basis of panoramic radiology. *Indian Journal of Dental Research*. 2010 Oct 1;21(4):468.
4. Castro-Ruiz CT, Noriega J, Guerrero ME. Validity of ridge mapping and cone beam computed tomography in dental implant therapy. *Journal of Indian Society of Periodontology*. 2015 May;19(3):290
5. ten Bruggenkate CM, de Rijcke TB, Kraaijenhagen HA, Oosterbeek HS. Ridge mapping. *Implant Dent* 1994;3: 179-182.
6. Allen F, Smith DG. An assessment of the accuracy of ridge-mapping in planning implant therapy for the anterior maxilla. *Clin Oral Implants Res* 2000;11: 34-38.