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From 2D to 3D: A Comparative Accuracy Assessment of Periapical and Panoramic Radiography Versus Cone Beam CT for Bone Height Evaluation in Pre-surgical Implant Planning

Ishan Roy Choudhury [1], Jayanta Bhattacharyya [2], Samiran Das [2], Soumitra Ghosh [2], Kaushik Dutta [3], Kritika Rajan [4, 1], Ishan Mukherji [5]

1. Prosthodontics and Implantology, Dr. R. Ahmed Dental College and Hospital, Kolkata, IND 2. Prosthodontics, Guru Nanak Institute of Dental Sciences and Research, Kolkata, IND 3. Oral Medicine and Radiology, Guru Nanak Institute of Dental Sciences and Research, Kolkata, IND 4. Prosthodontics and Implantology, SRM Dental College, Chennai, IND 5. Public Health Dentistry, Guru Nanak Institute of Dental Sciences and Research, Kolkata, IND

Corresponding author: Ishan Mukherji, imukherji713@gmail.com

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Abstract

Objective

This study aimed to compare the accuracy of bone height measurements obtained from periapical and panoramic radiography against cone-beam CT (CBCT) in pre-surgical implant planning, assessing their reliability and measurement discrepancies, as well as their impact on treatment planning and clinical decision-making.

Materials and methods

The study involved a sample of 60 implant sites, divided into three groups of 20 each. The key anatomical landmarks for the groups were the floor of the maxillary sinus, the roof of the mental foramen, and the roof of the inferior alveolar nerve canal. Acrylic stents bearing radiographic markers were used to take measurements at each site. Bone height was measured using three imaging modalities: intraoral periapical (IOPA) radiography, orthopantomogram (OPG), and CBCT. The measurements were compared for accuracy across these modalities.

Results

Descriptive analysis revealed mean bone height measurements of 7.95 ± 4.18 mm (IOPA), 8.86 ± 3.91 mm (OPG), and 9.00 ± 4.88 mm (CBCT) at the maxillary sinus floor; 15.81 ± 4.88 mm (IOPA), 15.17 ± 3.59 mm (OPG), and 15.13 ± 3.96 mm (CBCT) at the inferior alveolar nerve canal; and 12.98 ± 3.89 mm (IOPA), 12.15 ± 3.40 mm (OPG), and 12.31 ± 3.75 mm (CBCT) at the mental foramen. Analysis of variance (ANOVA) and Tukey's HSD (honestly significant difference) test showed no statistically significant differences among the imaging modalities ($p > 0.05$).

Conclusions

CBCT provides greater three-dimensional accuracy for implant planning than either periapical or panoramic radiography and allows a more detailed bone assessment, whereas conventional methods remain useful for screening.

Categories: Radiology, Dentistry
Keywords: bone height, cbct, dental implant, iopa grid, opg, paralleling technique, periapical radiograph

Introduction

Restoring a patient's normal occlusion, function, comfort, aesthetics, speech, and health, whether by removing caries from a tooth or replacing several teeth, is the ultimate goal of modern dentistry [1]. A dental implant is a surgical device used to replace a lost tooth. For implant placement, it is important to determine the relationship of the proposed implant to adjacent anatomical structures [2]. Treatment planning for dental implants in these sites is complicated by the unknown contour of the underlying anatomical structures [3,4]. The sites considered in the maxilla are the floor of the maxillary sinus and the nasal floor; in the mandible, they are the mental foramina, the roof of the inferior alveolar nerve canal, and the submandibular fossa [3]. Imaging modalities commonly used include intraoral periapical (IOPA) radiography, orthopantomogram (OPG), conventional CT, and cone-beam CT (CBCT) [5].

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Periapical radiographs can assess alveolar ridge height for implant placement and also help keep costs low and radiation exposure minimal [6,7]. The long-cone paralleling technique, used with film holders and grids, aids measurement, limits distortion, and thereby standardizes periapical radiography [8-12]. Digital OPG depicts the body of the mandible, the maxilla, and the inferior half of the maxillary sinuses in a single image at a lower cost [13-16]. CBCT produces three-dimensional images similar to those of CT, but at a lower cost and with a radiation dose comparable to that of panoramic radiography [17,18]. The present study compares bone height measurements at three sites (the floor of the maxillary sinus, the roof of the mental foramen, and the roof of the inferior alveolar nerve canal) obtained from IOPA, OPG, and CBCT.

Materials And Methods

Partially or completely edentulous patients from the West Bengal population, of either gender, aged over 18 years, and medically fit to undergo implant surgery were included in the study, which was conducted over a period of two years. The study variables were the bone height measurement (mm) at implant recipient sites and the imaging modality used for assessment, namely IOPA, OPG, and CBCT. The anatomical landmarks chosen for the study were the floor of the maxillary sinus, the roof of the mental foramen, and the roof of the inferior alveolar nerve canal.

Patients who had undergone recent extraction, trauma, or bone resection at the site, and those at risk from radiation exposure, such as those who were pregnant or had xerostomia or mucositis, were excluded. After ethical clearance and consultation with a statistician, a sample of 60 sites, comprising 20 subjects for each of the three radiographic procedures (three groups) at the same potential sites in the oral cavity, was determined (software used: Epi Info™, version 3.5.3, CDC, Atlanta, GA). Informed consent was obtained from all patients.

Acrylic stents were fabricated for the subjects after occlusal matching, using self-polymerizing acrylic resin (DPI-RR; Bombay Burmah Trading Corporation, Mumbai, India) (Figure *1*).



FIGURE 1: Radiographic stent (cameo surface)

Holes were drilled using a small 2 mm round bur (DFS Diamon GmbH, Riedenburg, Germany) on the intaglio surface of the corresponding teeth and were then filled with radiopaque gutta-percha (Sure-Endo; SureDent Co., Ltd., Seongnam, Gyeonggi-do, South Korea) to serve as markers for measurement (Figure *2*). For completely edentulous patients, the corresponding sites were demarcated on the pre-fabricated complete dentures, which were used as stents.



FIGURE 2: Radiographic stent (intaglio surface)

All measurements were made from the crest of the ridge in accordance with the base of the marker at the point nearest to the crest of the ridge, to the borders of the respective anatomical sites (the inferior margin of the maxillary sinus, superior border of the mental foramen, and superior border of the inferior alveolar canal).

Bone height determination using conventional IOPA radiography: After proper subject selection, a conventional IOPA radiograph was taken with the fabricated stent in place using an X-Mind Acteon, Satelec machine (Satelec, Acteon Group, Mérignac, France). The IOPA film, E-Speed (Carestream Health, Inc., White City, OR), was exposed at 70 kV and 10 mA for 0.6 seconds. A 1 mm^2 autoclavable nonmetallic grid (X-Ray Mesh Gauge Dental Size; Bluedent, Pirassununga, Brazil) was placed on the IOPA film, on the side facing the cone, and the radiograph was taken using the long-cone paralleling technique with an XCP Rinn IOPA film holder (Dentsply Sirona, Charlotte, NC).

As a standard for measurement, the vertical lead strip of the grid passing straight through both the marker and the landmark was used. The grid film measures exactly the size of the IOPA film (4 cm × 3 cm) and is made up of two strands of lead (thick and thin) incorporated both vertically and horizontally [11]. The corresponding blocks of 1 mm gap were counted between the two marks (Figure *3*). If the border of either the gutta-percha or the anatomical site lay between two grid markings, a divider and a millimeter scale were used to calculate the subdivisions of the millimeter, which were rounded off to 0.5 mm. For every set of IOPA radiographs, the values were recorded three times, and the mean of the three values was considered. The 60 values obtained for the three different sites were tabulated.

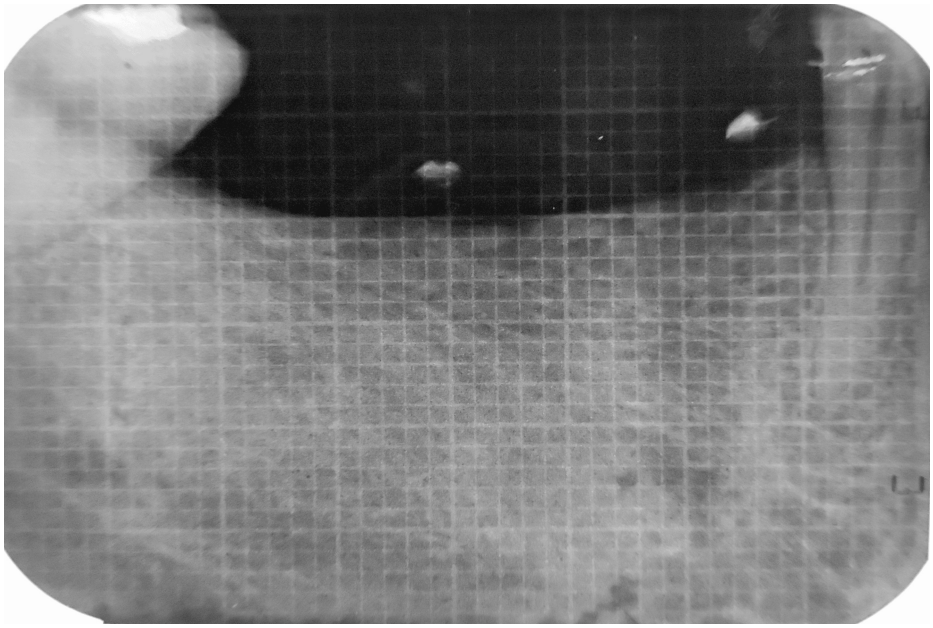


FIGURE 3: IOPA of the mental foramen and inferior alveolar canal

IOPA: intraoral periapical radiography

Bone height determination was performed using the X-Mind PanoD Plus digital orthopantomogram system. The stent was placed in the subject's mouth, after which the radiograph was taken. Exposure lasted 11 seconds at 70 kV and 10 mA. The DICOM file was evaluated using RadiAnt DICOM Viewer version 3.2.2 (64-bit) (Medixant, Poznan, Poland) (Figure *4*). Despite its various advantages, OPG is subject to variable distortions [3,13].

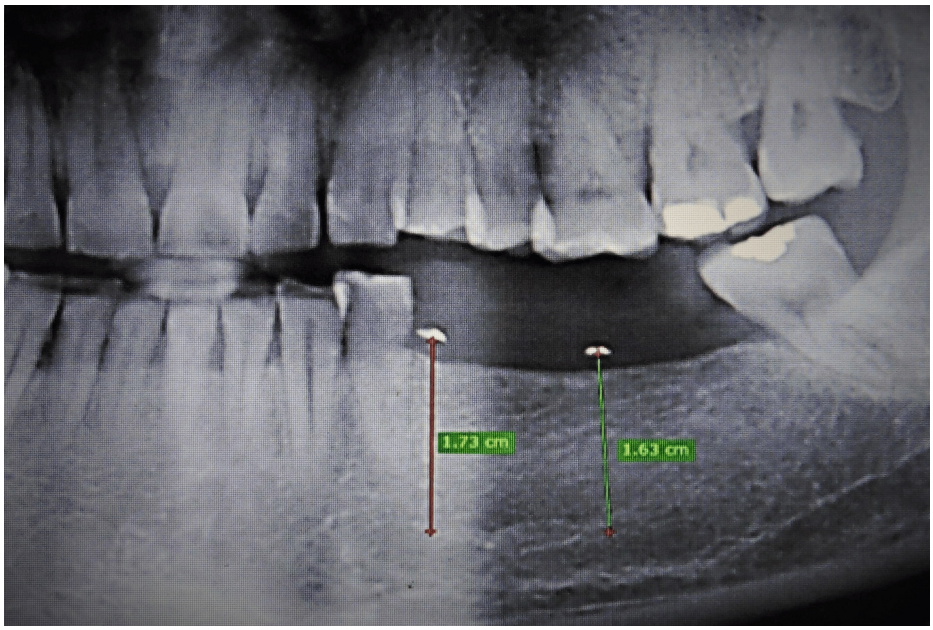


FIGURE 4: Measurements made on OPG

OPG: orthopantomogram

The actual values for each site were determined. Bone height determination was performed using the SkyView CBCT system (MyRay, Cefla S.C., Imola, Italy). Images were recorded at 90 kVp and 10 mA (maximum), with a total scan time of 15 seconds. A focal spot of 0.5 to 0.6 mm was maintained with an exposure time of 6.88 seconds. The image detector was a digital CCD sensor with a 7.4 µm pixel size, and the

voxel dimensions were 0.33 mm (field of view [FOV]: 15 cm), 0.23 mm (FOV: 11 cm), and 0.17 mm (FOV: 7 cm). Cross-sectional CBCT images were obtained at a slice thickness of 1 mm. The images were analyzed using the software provided by the manufacturer (MyRay, Cefla S.C., Imola, Italy) (Figure 5).

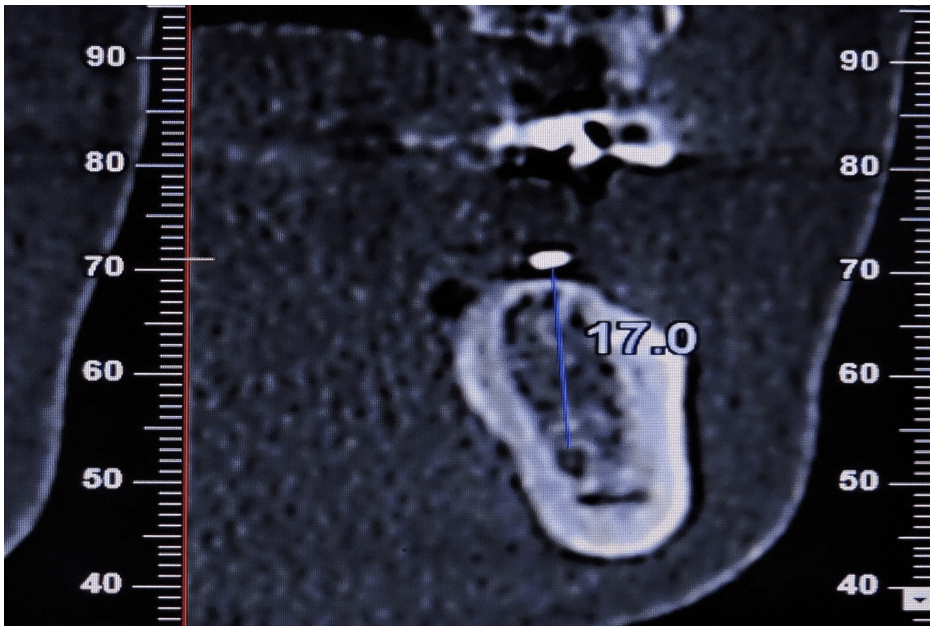


FIGURE 5: Measurements made on CBCT

CBCT: cone-beam computed tomography

An examiner performed all the recordings for the different imaging modalities (which were correlated with the other observers) to eliminate possible errors and lack of consistency with multiple investigators. The values obtained from the three techniques for each site were measured in millimeters.

Statistical analysis

For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS Statistics (IBM Corp., Armonk, NY) and GraphPad Prism, version 5.0 (GraphPad Software, San Diego, CA). Numerical variables were summarized using means and standard deviations (SD), while categorical variables were described with counts and percentages. One-way analysis of variance (ANOVA) demonstrated no statistically significant differences in bone height measurements among IOPA, OPG, and CBCT at any of the anatomical landmarks evaluated. Post-hoc analysis using Tukey's HSD (honestly significant difference) test was performed to compare the mean bone height measurements at the maxillary sinus floor, inferior alveolar canal, and mental foramen between IOPA, OPG, and CBCT. P-values ≤ 0.05 were considered statistically significant.

Results

The descriptive analysis showed that the mean bone height at the maxillary sinus floor was 7.95 ± 4.18 mm (95% confidence interval (CI): 5.99 to 9.91 mm) as measured by IOPA, 8.86 ± 3.91 mm (95% CI: 7.03 to 10.68 mm) by OPG, and 9.00 ± 4.88 mm (95% CI: 6.71 to 11.28 mm) by CBCT. For the inferior alveolar nerve canal, the mean bone height was 15.81 ± 4.26 mm (95% CI: 13.81 to 17.80 mm) with IOPA, 15.17 ± 3.59 mm (95% CI: 13.49 to 16.85 mm) with OPG, and 15.13 ± 3.96 mm (95% CI: 13.27 to 16.98 mm) with CBCT. At the mental foramen, the mean bone height was 12.98 ± 3.89 mm (95% CI: 11.15 to 14.80 mm) with IOPA, 12.15 ± 3.40 mm (95% CI: 10.56 to 13.74 mm) with OPG, and 12.31 ± 3.75 mm (95% CI: 10.56 to 14.07 mm) with CBCT (Table 1).

Descriptives									
		Sample size, N	Mean	Std. deviation	Std. error	95% confidence interval for mean		Minimum	Maximum
						Lower bound	Upper bound		
Maxillary sinus floor	IOPA	20	7.95	4.180	0.935	5.99	9.91	2	14
	OPG	20	8.86	3.908	0.874	7.03	10.68	3	15
	CBCT	20	9.00	4.876	1.090	6.71	11.28	2	17
	Total	60	8.60	4.292	0.554	7.49	9.71	2	17
ID canal	IOPA	20	15.805	4.2603	0.9526	13.811	17.799	7.0	23.0
	OPG	20	15.173	3.5876	0.8022	13.494	16.852	7.6	21.0
	CBCT	20	15.125	3.9586	0.8852	13.272	16.978	6.8	21.0
	Total	60	15.368	3.8902	0.5022	14.363	16.373	6.8	23.0
Mental foramen	IOPA	20	12.975	3.8949	0.8709	11.152	14.798	6.0	23.0
	OPG	20	12.145	3.3976	0.7597	10.555	13.735	6.0	18.1
	CBCT	20	12.310	3.7502	0.8386	10.555	14.065	6.8	20.0
	Total	60	12.477	3.6418	0.4702	11.536	13.417	6.0	23.0

TABLE 1: Descriptive statistics of bone height measurements by IOPA, OPG, and CBCT at the maxillary sinus floor, inferior alveolar (ID) canal, and mental foramen

IOPA: intraoral periapical radiograph; OPG: orthopantomogram; CBCT: cone-beam computed tomography

One-way ANOVA demonstrated no statistically significant differences in bone height measurements among IOPA, OPG, and CBCT at any of the anatomical landmarks evaluated. For the maxillary sinus floor, the between-group mean square was 6.435, and the within-group mean square was 18.838, yielding an F-value of 0.342 ($p = 0.712$). Similarly, for the inferior alveolar canal, the between-group mean square was 2.880, and the within-group mean square was 15.564, with an F-value of 0.185 ($p = 0.832$). For the mental foramen, the between-group mean square was 3.861, and the within-group mean square was 13.593, resulting in an F-value of 0.284 ($p = 0.754$). These findings indicate that the bone height measurements obtained using IOPA, OPG, and CBCT were statistically comparable at the maxillary sinus floor, inferior alveolar canal, and mental foramen ($p > 0.05$ for all comparisons) (Table *2*).

ANOVA						
		Sum of squares	df	Mean square	F	Sig.
Maxillary sinus floor	Between groups	12.871	2	6.435	0.342	0.712
	Within groups	1073.789	57	18.838	-	
	Total	1086.660	59	-	-	
ID canal	Between groups	5.761	2	2.880	0.185	0.832
	Within groups	887.140	57	15.564	-	
	Total	892.901	59	-	-	
Mental foramen	Between groups	7.722	2	3.861	0.284	0.754
	Within groups	774.785	57	13.593	-	
	Total	782.507	59	-	-	

TABLE 2: Comparison of bone height measurements obtained by IOPA, OPG, and CBCT at the maxillary sinus floor, inferior alveolar (ID) canal, and mental foramen using one-way ANOVA

IOPA: intraoral periapical radiograph; OPG: orthopantomogram; CBCT: cone-beam computed tomography

Post-hoc analysis using Tukey's HSD test was performed to compare the mean bone height measurements at the maxillary sinus floor between IOPA, OPG, and CBCT. The comparison between IOPA and OPG showed a mean difference of -0.905 mm (95% CI: -4.21 to 2.40; p = 0.788), while the difference between IOPA and CBCT was -1.045 mm (95% CI: -4.35 to 2.26; p = 0.728). The comparison between OPG and CBCT revealed a mean difference of -0.140 mm (95% CI: -3.44 to 3.16; p = 0.994). Conversely, the reverse comparisons showed similar non-significant differences, with OPG versus IOPA showing a mean difference of 0.905 mm (p = 0.788), CBCT versus IOPA showing 1.045 mm (p = 0.728), and CBCT versus OPG showing 0.140 mm (p = 0.994). Overall, Tukey's HSD analysis demonstrated no statistically significant differences in maxillary sinus floor measurements between any of the three imaging modalities (p > 0.05) (Table *3*).

Multiple comparisons							
Dependent variable: maxillary sinus floor							
	(I) GR	(J) GR	Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
						Lower bound	Upper bound
Tukey's HSD	IOPA	OPG	-0.905	1.373	0.788	-4.21	2.40
		CBCT	-1.045	1.373	0.728	-4.35	2.26
	OPG	IOPA	0.905	1.373	0.788	-2.40	4.21
		CBCT	-0.140	1.373	0.994	-3.44	3.16
	CBCT	IOPA	1.045	1.373	0.728	-2.26	4.35
		OPG	0.140	1.373	0.994	-3.16	3.44

TABLE 3: Multiple comparison of maxillary sinus floor measurements among different radiographic groups using Tukey's HSD test

IOPA: intraoral periapical radiograph; OPG: orthopantomogram; CBCT: cone-beam computed tomography

Post-hoc analysis using Tukey's HSD test was performed to compare the mean bone height measurements of the inferior alveolar canal between IOPA, OPG, and CBCT. The comparison between IOPA and OPG showed a mean difference of 0.632 mm (95% CI: -2.370 to 3.634; p = 0.868), while the difference between IOPA and

CBCT was 0.680 mm (95% CI: -2.322 to 3.682; p = 0.849). The comparison between OPG and CBCT revealed a minimal mean difference of 0.048 mm (95% CI: -2.954 to 3.050; p = 0.999). The reverse comparisons also demonstrated non-significant differences, with OPG versus IOPA showing a mean difference of -0.632 mm (p = 0.868), CBCT versus IOPA showing -0.680 mm (p = 0.849), and CBCT versus OPG showing -0.048 mm (p = 0.999). Overall, Tukey's HSD analysis revealed no statistically significant differences in inferior alveolar canal measurements between Intraoral Periapical Radiography, Orthopantomography, and Cone Beam Computed Tomography (p > 0.05) (Table *4*).

Multiple comparisons

Dependent variable: ID canal

	(I) GR	(J) GR	Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
						Lower bound	Upper bound
Tukey's HSD	IOPA	OPG	0.6320	1.2476	0.868	-2.370	3.634
		CBCT	0.6800	1.2476	0.849	-2.322	3.682
	OPG	IOPA	-0.6320	1.2476	0.868	-3.634	2.370
		CBCT	0.0480	1.2476	0.999	-2.954	3.050
	CBCT	IOPA	-0.6800	1.2476	0.849	-3.682	2.322
		OPG	-0.0480	1.2476	0.999	-3.050	2.954

TABLE 4: Multiple comparison of inferior alveolar canal measurements among different radiographic groups using Tukey's HSD test

IOPA: intraoral periapical radiograph; OPG: orthopantomogram; CBCT: cone-beam computed tomography

Post-hoc analysis using Tukey's HSD test was performed to compare the mean bone height measurements of the mental foramen between IOPA, OPG, and CBCT. The comparison between IOPA and OPG showed a mean difference of 0.830 mm (95% CI: -1.976 to 3.636; p = 0.757), while the difference between IOPA and CBCT was 0.665 mm (95% CI: -2.141 to 3.471; p = 0.836). The comparison between OPG and CBCT demonstrated a minimal mean difference of -0.165 mm (95% CI: -2.971 to 2.641; p = 0.989). The reverse comparisons also showed non-significant differences, with OPG versus IOPA showing a mean difference of -0.830 mm (p = 0.757), CBCT versus IOPA showing -0.665 mm (p = 0.836), and CBCT versus OPG showing 0.165 mm (p = 0.989). Overall, Tukey's HSD analysis revealed no statistically significant differences in mental foramen measurements between Intraoral Periapical Radiography, Orthopantomography, and Cone Beam Computed Tomography (p > 0.05) (Table *5*).

Multiple comparisons							
Dependent variable: mental foramen							
	(I) GR	(J) GR	Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
						Lower bound	Upper bound
Tukey's HSD	IOPA	OPG	0.8300	1.1659	0.757	-1.976	3.636
		CBCT	0.6650	1.1659	0.836	-2.141	3.471
	OPG	IOPA	-0.8300	1.1659	0.757	-3.636	1.976
		CBCT	-0.1650	1.1659	0.989	-2.971	2.641
	CBCT	IOPA	-0.6650	1.1659	0.836	-3.471	2.141
		OPG	0.1650	1.1659	0.989	-2.641	2.971

TABLE 5: Multiple comparison of mental foramen measurements among different radiographic groups using Tukey's HSD test

IOPA: intraoral periapical radiograph; OPG: orthopantomogram; CBCT: cone-beam computed tomography

Discussion

Studies comparing IOPA, OPG, and CBCT have been conducted in periodontics to assess the level of bone loss, as well as in orthodontics for the placement of mini-implants. A thorough literature search did not reveal any comparative study of IOPA, OPG, and CBCT for accuracy at specific implant sites. It is generally anticipated that CBCT, being a three-dimensional imaging modality, will show greater variation in values than two-dimensional imaging modalities. The null hypothesis was not rejected in this study because the results showed that the mean values did not differ significantly among the radiographic procedures. No significant difference could be established on comparison of any two groups or of all three groups together, for any of the three sites chosen.

The present study evaluated the accuracy of bone height measurements obtained from IOPA, OPG, and CBCT at key anatomical landmarks: the maxillary sinus floor, the inferior alveolar nerve canal, and the mental foramen. The mean bone height at the maxillary sinus floor was 7.95 ± 4.18 mm by IOPA, 8.86 ± 3.91 mm by OPG, and 9.00 ± 4.88 mm by CBCT. Similarly, the measurements at the inferior alveolar nerve canal and the mental foramen showed minimal differences among the three imaging modalities. These findings indicate that conventional radiographic techniques provided linear measurements comparable to those of CBCT in selected anatomical regions, although CBCT demonstrated slightly higher values and better anatomical visualization. Jamdade et al. emphasized the importance of accurate radiographic localization of anatomical landmarks such as the mental foramen for safe implant placement and the prevention of surgical complications [19].

In the present study, one-way ANOVA showed no statistically significant differences in bone height measurements among IOPA, OPG, and CBCT at the maxillary sinus floor ($p = 0.712$), the inferior alveolar nerve canal ($p = 0.832$), and the mental foramen ($p = 0.754$). These findings suggest that the three imaging modalities produced statistically comparable measurements. Baciut et al. reported that CBCT provided superior assessment of maxillary sinus anatomy compared with panoramic radiography, particularly during sinus grafting procedures, owing to its ability to provide three-dimensional visualization and accurate evaluation of residual bone height. Although panoramic radiography allowed an acceptable assessment, CBCT was considered more reliable in complex cases requiring detailed anatomical information [20].

In the present study, Tukey's HSD analysis revealed no significant differences among IOPA, OPG, and CBCT measurements of the maxillary sinus floor. The mean difference between IOPA and CBCT was −1.045 mm ($p = 0.728$), while OPG and CBCT showed a minimal difference of −0.140 mm ($p = 0.994$). These findings indicate that the measurement variations among the imaging modalities were not clinically significant. Dagassan-Berndt et al. reported that CBCT improved implant treatment planning, particularly in cases requiring augmentation procedures, by providing more accurate information regarding residual bone height, bone volume, and anatomical limitations compared with panoramic radiography [21].

In the present study, there were no statistically significant differences in inferior alveolar nerve canal measurements among IOPA, OPG, and CBCT. The difference between IOPA and CBCT was 0.680 mm ($p = 0.849$), whereas OPG and CBCT showed a nearly identical difference of 0.048 mm ($p = 0.999$). Accurate

assessment of the inferior alveolar nerve canal is essential to prevent nerve injury during implant placement. Luangchana et al. evaluated the accuracy of linear measurements using CBCT and panoramic radiography in dental implant treatment planning and reported that CBCT showed higher measurement accuracy owing to the reduced distortion and magnification errors associated with two-dimensional imaging techniques [22].

The present study found that CBCT, OPG, and IOPA measurements of the inferior alveolar nerve canal and other anatomical landmarks were comparable; however, CBCT provided better visualization of critical structures. Özalp et al. compared panoramic radiography and CBCT for avoiding anatomical structures critical to dental implant surgery and reported that CBCT was superior for identifying structures such as the mandibular canal and for improving surgical safety [23]. Similarly, Tandogdu et al. demonstrated that CBCT enhanced the accuracy of implant treatment planning in complex rehabilitation cases by providing a detailed three-dimensional assessment of bone anatomy [24].

The present study observed no statistically significant differences in mental foramen measurements among IOPA, OPG, and CBCT. The mean differences between IOPA and OPG (0.830 mm, $p = 0.757$), IOPA and CBCT (0.665 mm, $p = 0.836$), and OPG and CBCT (−0.165 mm, $p = 0.989$) were minimal. These findings indicate that all three imaging techniques provided comparable measurements of the mental foramen region. Correa et al. reported that CBCT provided accurate linear measurements for dental implant treatment planning and demonstrated advantages over panoramic radiography by reducing measurement errors and improving diagnostic reliability [25].

The findings of the present study were consistent with those of Shahidi et al., who compared panoramic radiography and CBCT for measuring vertical bone height at different locations of the posterior mandibular alveolar process. They reported good agreement between panoramic radiography and CBCT measurements, although CBCT showed superior visualization of cortical bone and anatomical structures. The authors emphasized that CBCT provides additional diagnostic value when precise assessment of implant site anatomy is required [26]. Similarly, Ayob et al. compared digital panoramic radiography and CBCT for pre-surgical implant vertical height measurement at the posterior mandible and found comparable measurements between the two modalities. However, CBCT was considered more advantageous because of its ability to provide three-dimensional evaluation, accurate localization of vital structures, and improved surgical planning [27].

Limitations

The present study has certain limitations. Locating and placing the radiological marker exactly over the site of the mental foramen was difficult because of tongue movement or the limited space for the film. The IOPA film could not be stored for a prolonged period, as it fades due to residual fixer solution. The grid lines had a 1 mm gradation between them, so measurements could only be approximated to the nearest 0.5 mm. Assessment of the sites by digital methods in OPG and CBCT gave more variation in measurements, with values ranging from 0.1 to 0.9 mm.

Conclusions

The results of this study apply only to the study group. The results indicate that it is ideal to take periapical radiographs using the paralleling technique, which results in minimal superimposition of the zygomatic process of the maxilla over the maxillary molar region. Millimeter radiopaque grids used as an adjunct enhance the accuracy of IOPA radiographs, but they may obscure underlying anatomical structures.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Ishan Mukherji, Ishan Roy Choudhury, Jayanta Bhattacharyya, Samiran Das, Soumitra Ghosh, Kaushik Dutta, Kritika Rajan

Critical review of the manuscript for important intellectual content: Ishan Mukherji, Ishan Roy Choudhury, Jayanta Bhattacharyya, Samiran Das, Soumitra Ghosh, Kaushik Dutta, Kritika Rajan

Acquisition, analysis, or interpretation of data: Ishan Roy Choudhury, Jayanta Bhattacharyya, Samiran Das, Soumitra Ghosh, Kaushik Dutta, Kritika Rajan

Drafting of the manuscript: Ishan Roy Choudhury, Jayanta Bhattacharyya, Samiran Das, Soumitra Ghosh, Kaushik Dutta, Kritika Rajan

Supervision: Ishan Roy Choudhury, Jayanta Bhattacharyya, Samiran Das, Soumitra Ghosh, Kaushik Dutta,

Kritika Rajan

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Ethics Committee, Guru Nanak Institute of Dental Sciences and Research issued approval NA. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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