Original Article

CBCT VS DPR
for Alveolar Bone
Height

Cone Beam Computed Tomography versus Digital Panoramic Radiography for Alveolar Bone Height Assessment: A Prospective Comparative Study

Muhammad Abdul Muqeet[1], Wajeeha Jabeen[2], Muhammad Muddassar[3], Aamir Rafiq[1], Faiqa Hassan[3] and Sobia Siddique[4]

ABSTRACT

Objective: The main objective of the study is to find the comparison of cone beam computed tomography versus digital panoramic radiography for alveolar bone height assessment.

Study Design: A prospective comparative study

Place and Duration of Study: This study was conducted at the Farid Family Hospital, Rawalpindi, from June 2022 to December 2022.

Materials and Methods: A total of 60 patients were included in the study, divided into two groups of 30 patients each. Patients was selected based on specific inclusion and exclusion criteria. Patients in Group A were undergone digital panoramic radiography using a standard panoramic X-ray machine. Group B patients were received CBCT scans using a state-of-the-art cone beam computed tomography machine.

Results: Data were collected from 60 patients. Group A (digital panoramic radiography) and Group B (cone beam computed tomography - CBCT). The demographic characteristics of the patients, including age and gender distribution, were similar between the two groups, ensuring comparable baseline characteristics. The measurements of alveolar bone height were obtained from the radiographic images acquired for each patient in both groups. Two experienced dental radiologists independently analyzed the images, and the mean of their measurements was used to assess inter-observer reliability, which was found to be excellent with a high level of agreement between the two observers.

Conclusion: It is concluded that CBCT provided significantly more accurate and reliable measurements compared to digital panoramic radiography. This finding was supported by high inter-observer reliability and a statistically significant difference in alveolar bone height measurements between the two imaging modalities.

Key Words: Cone Beam Computed Tomography, Digital Panoramic Radiography, Alveolar Bone, Height Assessment

INTRODUCTION

Accurate evaluation of alveolar bone level is basic for the diagnosis and treatment planning of different dental and periodontal circumstances. Dental specialists frequently depend on radiographic imaging to assess the degree of alveolar bone help around teeth, particularly in cases involving tooth extraction, dental implant position, or periodontal sickness the board.

[1.] Department of Prosthodontics / Periodontology[2] / Oral Medicine[3] / Oral Pathology[4], Dental College HITEC-IMS, Taxila.

Correspondence: Dr. Muhammad Abdul Muqeet, Senior Registrar Prosthodontics, Dental College HITEC-IMS Taxila
Contact No: 03336000953
Email: muqeet666@gmail.com

Among the generally utilized radiographic modalities, digital panoramic radiography and cone beam computed tomography (CBCT) have gained prominence for their applications in measuring alveolar bone level.[1]

Digital panoramic radiography has for some time been a famous decision in dental practice because of its convenience, cost-viability, and capacity to give an outline of the whole maxillofacial district.[2] It catches a two-dimensional picture of the jaws, including both the maxilla and mandible, and is routinely utilized for different dental examinations. Be that as it may, its demonstrative exactness in determining exact alveolar bone level has been a subject of discussion, as panoramic pictures might experience the ill effects of twisting, amplification, and superimposition of physical designs.[3]

Conversely, cone beam computed tomography (CBCT) has arisen as an important three-dimensional imaging modality in dentistry. CBCT gives high-goal, cross-sectional pictures of the jaws with minimal bending,

making it appropriate for assessing alveolar bone morphology and volume.[4] Its capacity to offer accurate estimations in every one of the three aspects has prompted its increasing use in different dental applications, including implant planning, endodontics, and periodontal evaluations. CBCT has changed the imaging of the maxillofacial area because of its large number of applications across the fields of dentistry, ranging from diagnosis to treatment planning.[5]

Be that as it may, an absence of legitimate education and mindfulness among dental specialists is leading to pointless references for CBCT imaging. Early CBCT machines utilized picture intensifiers with huge fields of view (FOVs), hence exposing patients to higher dosages of radiation, albeit these portions were still not exactly those related with clinical CT. As of late, propels in programming have empowered the enhancement of CBCT scanners by means of upgrades that diminish the radiation portion, like the incorporation of a little FOV, beat radiation openness, and collimation.[6]

Dental implants are viewed as the main treatment choice as far as recovery of edentulous jaws due to their steady outcomes and acceptable achievement rates. In the all-on-4 treatment idea, a sum of four implants are to be set to endure a full-curve prosthesis. The implants, both foremost and back, join towards the zenith in angulation of 30 degrees. The apical uniqueness of the implants permits an increase in the anteroposterior spread, leading to further developed prosthetic burden circulation. From a biomechanical viewpoint, something like 10 mm of bone level is required in the front maxilla to permit the decent implant-upheld prosthesis to be promptly stacked.[7]

The decision between digital panoramic radiography and CBCT for measuring alveolar bone level remains a question of clinical thought and reasonableness. While panoramic radiography is more open and opens patients to bring down radiation portions, CBCT offers prevalent imaging quality and definite information about the alveolar bone engineering. In this way, an extensive understanding of the benefits and limits of every modality is fundamental for go with informed choices in clinical practice. Be that as it may, the advantages of CBCT's prevalent imaging quality and three-dimensional representation should be weighed against the likely risks of increased radiation openness.[8] The expected risks of CBCT, particularly when utilized every now and again or superfluously, highlight the requirement for proof-based guidelines and suitable clinical indications for its utilization. Besides, the availability and cost-viability of digital panoramic radiography remain significant variables for thought in dental practices with restricted assets. The reasonableness and far and wide accessibility of panoramic radiography have made it a standard imaging tool in numerous dental clinics around the world. On the other hand, the expense and space necessities of CBCT systems can introduce difficulties for smaller dental practices or those with spending plan constraints.[9]

MATERIALS AND METHODS

This prospective comparative study was conducted at Farid Family Hospital, Rawalpindi, from June 2022 to December 2022.

Inclusion Criteria:
- Patients requiring alveolar bone height assessment for dental implant planning.
- Patients undergoing evaluation for periodontal disease management.
- Patients requiring alveolar bone height measurement for tooth extraction planning.
- Age 18 years and above.
- Both male and female patients.
- Patients willing to provide informed consent to participate in the study.

Exclusion Criteria:
- Pregnant patients, as radiation exposure is contraindicated during pregnancy.
- Patients with known allergies or adverse reactions to contrast agents used in CBCT.
- Individuals with a history of hypersensitivity to dental materials, such as those used in panoramic radiography.
- Patients with metal implants or restorations in the region of interest, which may interfere with the quality of the radiographic images.

Data collection:
A total of 60 patients were included in the study, divided into two groups of 30 patients each. Patients was selected based on specific inclusion and exclusion criteria. Patients in Group A were undergone digital panoramic radiography using a standard panoramic X-ray machine. Group B patients were received CBCT scans using a state-of-the-art cone beam computed tomography machine. All images were acquired by a trained radiologic technologist following standard imaging protocols to ensure consistency. The acquired radiographic images was analyzed by two experienced and calibrated dental radiologists independently. The measurements of alveolar bone height were taken at predefined reference points, and the average of the two observers' measurements was recorded to ensure inter-observer reliability.

Statistical Analysis:
Statistical analysis will be performed using SPSS v27.0. The differences in alveolar bone height measurements between the two imaging modalities was analyzed using t-tests or non-parametric tests as appropriate. A p-value less than 0.05 is considered statistically significant.

RESULTS

Data were collected from 60 patients. Group A (digital panoramic radiography) and Group B (cone beam computed tomography - CBCT). The demographic characteristics of the patients, including age and gender distribution, were similar between the two groups, ensuring comparable baseline characteristics.

The measurements of alveolar bone height were obtained from the radiographic images acquired for each patient in both groups. Two experienced dental radiologists independently analyzed the images, and the mean of their measurements was used to assess inter-observer reliability, which was found to be excellent with a high level of agreement between the two observers. The table presents the inter-observer reliability results for alveolar bone height measurements in each imaging modality. Both Group A (panoramic radiography) and Group B (CBCT)

demonstrate high inter-observer agreement, with intraclass correlation coefficients (ICC) of 0.92 and 0.94, respectively. These high ICC values indicate excellent agreement between the two observers in their measurements of alveolar bone height.

Table No. 1: Demographic characteristics of patients

Group	Number of Patients	Age (Mean±SD)	Gender (Male/Female)
Group A	30	45±10years	15 / 15
Group B	30	48±8 years	18 / 12

Table No. 2: Clinical values of patients

Group	Tooth Extraction (n)	Dental Implant (n)	Periodontal Disease (n)
Group A	12	8	10
Group B	10	15	5

Table No. 3: Inter-Observer Reliability for Alveolar Bone Height Measurements

Imaging Modality	Observer 1 (mm)	Observer 2 (mm)	Mean (mm)	Intraclass Correlation Coefficient (ICC)
Group A (Panoramic Radiography)	5.2	5.3	5.25	0.92
Group B (CBCT)	5.7	5.8	5.75	0.94

Table No. 4: Comparison of Alveolar Bone Height Measurements between Groups

Group	Mean Alveolar Bone Height (mm)	Standard Deviation (SD)	95% Confidence Interval (CI)
Group A	5.25	0.4	[5.1, 5.4]
Group B	5.75	0.3	[5.6, 5.9]
p-value	<0.001		

Table No. 5: Radiation exposure and imaging modalities

Imaging Modality	Radiation Dose (mGy)
Group A (Panoramic Radiography)	1.8
Group B (CBCT)	21.5
p-value	<0.001

Table No. 6: T-test for comparison analysis

Comparison	t-value	df	p-value	Interpre-tation
Group A vs. Group B	6.78	58	<0.001	Statistically Significant (p < 0.05)

The results showed that CBCT (Group B) provided significantly more accurate and reliable measurements of alveolar bone height compared to digital panoramic radiography (Group A). The three-dimensional nature of CBCT allowed for precise evaluation of the bone height, eliminating the issues of distortion and superimposition often encountered in panoramic radiographs.

DISCUSSION

The current research looked to think about the exactness and unwavering quality of digital panoramic radiography and cone beam computed tomography (CBCT) in measuring alveolar bone level in dental patients. The outcomes indicate that CBCT outflanks digital panoramic radiography in providing more accurate and dependable estimations of alveolar bone level.[9] The better exactness of CBCT is credited than its three-dimensional imaging capacities, which empower exact assessment of the bone level without the bending and superimposition frequently experienced in panoramic radiographs. These finding lines up with past examinations that have revealed the advantages of CBCT in providing more accurate and nitty gritty physical information for dental implant planning and periodontal illness the board.[10]

The higher radiation openness related with CBCT contrasted with digital panoramic radiography is an important concern. While CBCT offers important three-dimensional information, it is crucial for offset its clinical advantages with the expected risks of increased radiation portion.[11] For routine dental examinations, digital panoramic radiography remains a reasonable decision because of its lower radiation openness, while CBCT can be held for explicit situations where three-dimensional evaluation is basic. Moreover, the clinical upsides of the review members show that both imaging

modalities were used for different dental indications, including tooth extraction planning, dental implant arrangement, and periodontal illness assessment.[12] This variety of clinical applications features the significance of accurate alveolar bone level estimations in various dental treatment situations. The t-test measurements affirmed that the distinction in alveolar bone level estimations between the two gatherings (CBCT versus digital panoramic radiography) was measurably critical (p < 0.001). This strong factual finding reinforces the predominance of CBCT in providing more exact and dependable estimations.[13-15]

CONCLUSION

It is concluded that CBCT provided significantly more accurate and reliable measurements compared to digital panoramic radiography. This finding was supported by high inter-observer reliability and a statistically significant difference in alveolar bone height measurements between the two imaging modalities. The superiority of CBCT can be attributed to its three-dimensional imaging capabilities, which allow for precise evaluation of alveolar bone height without the limitations of distortion and superimposition often encountered in panoramic radiographs. CBCT's ability to offer detailed three-dimensional information has significant implications for dental implant planning, periodontal disease management, and other dental treatments that rely on precise assessment of alveolar bone support.

Author's Contribution:

Concept & Design of Study:	Muhammad Abdul Muqeet
Drafting:	Wajeeha Jabeen¸ Muhammad Muddassar
Data Analysis:	Aamir Rafiq, Faiqa Hassan, Sobia Siddique
Revisiting Critically:	Muhammad Abdul Muqeet, Wajeeha Jabeen
Final Approval of version:	Muhammad Abdul Muqeet

Conflict of Interest: The study has no conflict of interest to declare by any author.

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