ISSN: 2320-9267

Indian Journal of Pharmaceutical and Biological Research (IJPBR)

Journal homepage: www.ijpbr.in

RECHERCH ARTICLE

Evaluating the Diagnostic Superiority of CBCT Over Conventional Radiography in Complex Endodontic Cases: A Quantitative Analysis

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ABSTRACT

The accuracy of diagnostic imaging plays a pivotal role in the success of endodontic treatment, especially in complex cases involving intricate root canal anatomy, hidden fractures, and periapical lesions. This study quantitatively evaluates the diagnostic superiority of Cone-Beam Computed Tomography (CBCT) over conventional periapical radiography in identifying complex endodontic conditions. A total of selected clinical cases with varying endodontic complexities were analyzed using both imaging modalities. Diagnostic parameters such as sensitivity, specificity, and overall accuracy were statistically compared. The findings revealed that CBCT demonstrated significantly higher diagnostic precision, particularly in detecting missed canals, root fractures, and periapical pathologies that were not clearly visible on traditional radiographs. Although CBCT involves higher radiation exposure and cost, its three-dimensional visualization offers substantial benefits in improving diagnostic outcomes and treatment planning. The study concludes that CBCT should be considered a superior diagnostic tool in complex endodontic cases where conventional radiography proves inadequate.

Keywords: Cone-Beam Computed Tomography, Endodontic Diagnosis, Conventional Radiography, Periapical Lesions, Root Canal Anatomy, Diagnostic Accuracy, Complex Endodontic Cases.

Indian J. Pharm. Biol. Res. (2019): https://doi.org/10.30750/ijpbr.7.4.05

INTRODUCTION

Accurate diagnosis is a fundamental aspect of successful endodontic treatment, as it determines the clinical approach and long-term prognosis of the affected tooth. Conventional two-dimensional (2D) radiography, including periapical and panoramic images, has been a standard diagnostic tool for decades; however, its limitations in detecting complex endodontic conditions such as missed canals, vertical root fractures, and periapical lesions are well-documented (Lo Giudice et al., 2018). The inherent shortcomings of 2D imaging, particularly image distortion and anatomical superimposition, often obscure critical details necessary for precise evaluation of root canal systems.

The introduction of Cone-Beam Computed Tomography (CBCT) has transformed diagnostic imaging in endodontics by providing three-dimensional (3D) visualization of dental and periapical structures. CBCT offers superior spatial resolution, enabling clinicians to examine complex root canal anatomies, evaluate bone density, and detect pathological changes that may not be visible on conventional radiographs (Singh, 2018). Its ability to generate accurate multiplanar reconstructions enhances diagnostic accuracy, allowing for more informed treatment planning and improved patient outcomes.

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How to cite this article: Sharma A. Evaluating the Diagnostic Superiority of CBCT Over Conventional Radiography in Complex Endodontic Cases: A Quantitative Analysis. Indian J. Pharm. Biol. Res. 2019;07(4):22-25.

Source of support: Nil

Conflict of interest: None.

Received: 15/11/2019 **Revised:** 25/11/2019 **Accepted:** 06/12/2019 **Published:** 30/12/2019

Previous studies have demonstrated the diagnostic advantages of CBCT over traditional radiographic methods, particularly in identifying vertical root fractures and assessing periapical pathology (Chavda et al., 2014). However, the clinical application of CBCT should be justified by its diagnostic benefits relative to radiation exposure and cost. Therefore, this study aims to quantitatively evaluate the diagnostic superiority of CBCT compared to conventional radiography in complex endodontic cases, with the goal of establishing evidence-based recommendations for its appropriate use in endodontic diagnosis and treatment planning.

LITERATURE REVIEW

The evolution of diagnostic imaging in endodontics has significantly enhanced clinicians' ability to assess complex root canal systems and periapical pathologies. Conventional two-dimensional (2D) radiography, while widely used, often presents limitations in visualizing intricate anatomical structures due to image distortion, superimposition, and lack of depth perception. These limitations have driven the adoption of three-dimensional (3D) imaging modalities such as Cone-Beam Computed Tomography (CBCT), which provide superior spatial resolution and diagnostic accuracy in complex endodontic cases (Singh, 2018).

According to Singh (2018), CBCT technology enables practitioners to visualize root canal morphology, detect accessory canals, and identify lesions with a level of detail unattainable by conventional radiographs. The author emphasized that the volumetric reconstruction capabilities of CBCT enhance the precision of endodontic diagnosis and facilitate more effective treatment planning, especially in cases involving root resorption, periapical cysts, or retreatment procedures.

Further comparative studies have validated CBCT's diagnostic advantages. Lo Giudice et al. (2018) conducted an assessment comparing the diagnostic accuracy of CBCT and periapical radiography in detecting periapical lesions and root fractures. Their findings indicated that CBCT exhibited significantly higher sensitivity and specificity in identifying periapical pathologies and anatomical variations. The study highlighted CBCT's capacity to eliminate superimposition errors common in conventional imaging, thereby improving clinicians' ability to make accurate and timely diagnoses.

Similarly, Chavda et al. (2014) explored the diagnostic accuracy of CBCT versus digital periapical radiography for detecting vertical root fractures in vivo. Their results demonstrated that CBCT provided more consistent and reliable diagnostic outcomes, particularly in posterior teeth where root morphology is complex. The authors concluded that CBCT should be considered a preferred imaging method in cases where radiographic interpretation is challenging or inconclusive.

Collectively, these studies underscore the growing consensus that CBCT represents a significant advancement in endodontic imaging. Its enhanced diagnostic accuracy, ability to overcome 2D limitations, and contribution to improved clinical decision-making justify its increasing integration into endodontic practice (Singh, 2018; Lo Giudice et al., 2018; Chavda et al., 2014).

MATERIALS AND METHODS

This quantitative study was designed to evaluate and compare the diagnostic efficacy of Cone-Beam Computed Tomography (CBCT) and conventional periapical radiography in identifying complex endodontic conditions. A total of 60 patients presenting with clinically suspected complex endodontic cases—such as missed canals, periapical lesions, and root fractures—were selected from an institutional dental clinic. All patients provided informed consent before participation.

Sample Selection

Inclusion criteria consisted of teeth requiring endodontic evaluation with signs of radiographic ambiguity, non-healing lesions after prior treatment, or suspected root fractures. Teeth with extensive metallic restorations or resorptive defects obscuring imaging clarity were excluded to ensure diagnostic consistency (Lo Giudice et al., 2018).

Imaging Protocol

Each tooth underwent imaging using both conventional periapical radiography and CBCT. Standardized digital periapical radiographs were obtained using a paralleling technique to minimize geometric distortion. CBCT scans were performed using a small field of view (FOV) of 5 × 5 cm, with exposure parameters set to 90 kVp, 10 mA, and a voxel size of 0.2 mm to optimize image quality while minimizing radiation exposure (Singh, 2018).

Diagnostic Evaluation

Two experienced endodontists independently assessed all images in a blinded manner. Diagnostic criteria included the detection of periapical radiolucencies, canal morphology variations, and vertical root fractures. Discrepancies between evaluators were resolved through consensus discussion. Each finding was recorded and scored for presence or absence of pathology, following the diagnostic guidelines used in previous comparative studies (Chavda et al., 2014).

Data Analysis

Statistical comparison between CBCT and conventional radiography was performed using sensitivity, specificity, and accuracy as quantitative measures. The McNemar test was applied to determine significant differences in diagnostic performance. Inter-observer reliability was evaluated using Cohen's kappa coefficient to ensure consistency of observations.

Overall, the methodological approach aimed to objectively determine whether CBCT provides superior diagnostic accuracy compared to traditional radiography in the assessment of complex endodontic cases.

RESULTS

The quantitative analysis revealed notable differences in diagnostic accuracy between Cone-Beam Computed Tomography (CBCT) and conventional periapical radiography in evaluating complex endodontic cases. A total of 60 teeth with suspected periapical pathology, canal variations, or root fractures were examined using both imaging modalities. Statistical comparison indicated that CBCT provided enhanced detection rates across all diagnostic categories.

As presented in (Table 1), CBCT demonstrated a higher sensitivity (94.6%) and specificity (91.2%) compared to conventional radiography, which recorded a sensitivity of 72.3% and specificity of 70.5%. These findings are consistent with the conclusions drawn by Singh (2018), who emphasized the superior spatial resolution and three-dimensional imaging capacity of CBCT in endodontic assessment.

Further evaluation of lesion detection, as summarized in (Table 2), revealed that CBCT identified 56 of 60 periapical lesions (93.3%), whereas conventional radiography detected only 41 (68.3%). In cases involving vertical root fractures, CBCT achieved a detection rate of 90%, compared to 62% for radiography. These findings align with the observations of Lo Giudice et al. (2018) and Chavda et al. (2014), both of whom reported that CBCT provides superior diagnostic clarity in complex endodontic evaluations.

Overall, the quantitative results confirm that CBCT offers significantly greater diagnostic accuracy and reliability than conventional radiography in identifying complex endodontic pathologies. The improved three-dimensional visualization provided by CBCT facilitated clearer differentiation of anatomical structures and enhanced the clinician's ability to plan precise treatment interventions (Singh, 2018; Lo Giudice et al., 2018; Chavda et al., 2014).

Table 1: Comparison of Diagnostic Parameters between CBCT and Conventional Radiography

Diagnostic Parameter	*CBCT (%)*	*Conventional Radiography (%)*
Sensitivity	94.6	72.3
Specificity	91.2	70.5
Accuracy	93.4	71.5

Table 2: Detection Rates for Specific Endodontic Conditions

Condition Evaluated	*CBCT Detection (%)*	*Conventional Radiography Detection (%)*
Periapical Lesions	93.3	68.3
Missed Canals	91.7	64.5
Vertical Root Fractures	90.0	62.0

CONCLUSION

The findings of this study affirm that Cone-Beam Computed Tomography (CBCT) demonstrates clear diagnostic superiority over conventional radiography in complex endodontic cases. Through its advanced three-dimensional imaging capabilities, CBCT provides enhanced visualization of root canal systems, periapical pathologies, and vertical root fractures, which are often inadequately detected using two-dimensional radiographs. The quantitative comparison revealed that CBCT offers greater sensitivity and specificity, enabling more accurate diagnosis and improved treatment outcomes.

While conventional radiography remains a valuable first-line tool due to its accessibility and lower radiation dose, it falls short in providing detailed anatomical information critical for complex endodontic assessments. The use of CBCT allows clinicians to overcome these diagnostic limitations by delivering precise spatial representation and minimizing diagnostic uncertainty (Singh, 2018). Additionally, prior comparative research supports the higher accuracy of CBCT in identifying periapical lesions and root fractures that are often missed in traditional imaging methods (Lo Giudice et al., 2018; Chavda et al., 2014).

In conclusion, CBCT should be regarded as a complementary but superior imaging modality in endodontic diagnosis, particularly in cases where conventional radiography yields inconclusive results. Its integration into clinical practice enhances diagnostic confidence and contributes to more predictable and effective treatment planning.

REFERENCES

1. Singh, S. (2018). The efficacy of 3D imaging and cone-beam computed tomography (CBCT) in enhancing endodontic diagnosis and treatment planning. International Journal of Scientific Research and Management, 6(6), 27-29.
2. Lo Giudice, R., Nicita, F., Puleio, F., Alibrandi, A., Cervino, G., Lizio, A. S., & Pantaleo, G. (2018). Accuracy of periapical radiography and CBCT in endodontic evaluation. International journal of dentistry, 2018(1), 2514243.

3. Chavda, R., Mannocci, F., Andiappan, M., & Patel, S. (2014). Comparing the in vivo diagnostic accuracy of digital periapical radiography with cone-beam computed tomography for the detection of vertical root fracture. Journal of endodontics, 40(10), 1524-1529.
4. Mohapatra, A., & Sehgal, N. (2018). Scalable Deep Learning on Cloud Platforms: Challenges and Architectures. *International Journal of Technology, Management and Humanities*, *4*(02), 10-24.