REVIEW ARTICLE

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Role of CBCT in diagnosing periodontal disease: a literature review

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ABSTRACT

Objectives: This review article aims to provide scientific information regarding the role of CBCT in diagnosing periodontal disease.

Review: This literature review was conducted using an electronic database search method via Google Scholar. The keywords used were 'CBCT related to periodontal disease'. The inclusion criteria included journal articles published between 2019 and 2024. Articles were selected and filtered based on publication year, relevance to the topic, and research quality, resulting in 10 journal articles used in this review. Periodontal disease is described as an inflammatory condition affecting both soft and hard periodontal structures. It typically began as gingivitis, a mild and self-limiting inflammation. Intraoral radiographs, such as periapical and bitewing images, were the most commonly used tools for periodontal assessment, offering clear visualization of teeth, alveolar bone, and periodontal ligament space with minimal radiation exposure. However, intraoral radiographs have limitations, including difficulty visualizing bucco-lingual bone loss and a tendency to underestimate early-stage alveolar bone resorption. CBCT revealed bony abnormalities that might have been overlooked in routine clinical and radiographic assessments. Nevertheless, evidence supporting its ability to improve short- and long-term periodontal treatment outcomes remained limited.

Conclusion: CBCT played a crucial role in diagnosing periodontal disease by providing superior three-dimensional imaging compared to conventional radiographs. However, its limitations included potential overestimation or underestimation of bone thickness due to voxel size, artifacts, and soft tissue overlap. Additionally, its higher radiation dose required careful clinical consideration.

Keywords: *Bone loss, cone-beam computed tomography, periodontal disease*

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INTRODUCTION

Periodontal diseases range from mild gingivitis to severe periodontitis. Gingivitis only affects the gingiva without involving the supporting structures of the teeth, such as the alveolar bone. In contrast, periodontitis extends to the alveolar bone, starting with the formation of a periodontal pocket and potentially leading to bone and tooth loss if untreated. Furcation defects may also develop in molar-premolar teeth. Gingivitis is diagnosed and treated based on clinical signs like redness, puffiness, and bleeding, while periodontitis requires clinical evaluation and radiographic imaging to assess bone resorption and plan treatment.[1] Periodontitis is primarily classified into aggressive periodontitis and chronic periodontitis. Early diagnosis is essential for effective treatment and prognosis. Traditional diagnostic methods like periodontal probing, bone sounding, and intraoral radiography have limitations. Probing can be inaccurate due to factors like probe size, force, and tissue resistance. Bone sounding, while accurate, is invasive, and intraoral radiographs can suffer from projection errors, making it difficult to assess bone loss and defects accurately.[2] Poorly controlled periodontal diseases lead to attachment loss, bone loss, and, in severe cases, tooth loss. Accurate diagnosis is crucial for managing the disease.[3]

Radiographs have long been essential in diagnosing periodontitis, one of the most common chronic diseases globally.[4] Traditionally, diagnosis relies on 2D radiographs combined with clinical evaluations like probing depths and bone sounding. While 2D imaging is cost-effective, high-resolution, and has minimal radiation exposure, it has limitations, such as underestimating bone loss due to projection and observer errors. It can also make it difficult to diagnose defects in areas like the buccal, lingual, or furcation regions, often requiring further surgical procedures. Direct visualization via flap reflection may help, but it can lead to longer surgeries, unproductive outcomes, and delays in discussing alternative treatments.[3] In dental practice, professionals commonly use conventional radiographs, including periapical, bitewing, and panoramic x-rays, to assess bone loss and the overall condition of periodontal disease.[1]

Cone Beam Computed Tomography (CBCT) is an effective imaging tool for diagnosing 3D structures, offering accurate quantification and localization of anatomical features. With its widespread use, CBCT enables better visualization of bony defects and furcations, providing a less invasive approach and serving as a valuable tool for patient education.[3] CBCT offers lower radiation exposure compared to conventional CT. It uses a conical radiographic source and a digital panel detector, similar in size to a panoramic machine. The scan takes just 30 seconds, with radiation levels comparable to intraoral full-mouth radiographs. Additionally, CBCT provides higher resolution, with adjustments as fine as 0.1 mm, compared to 0.5–1 mm for conventional CT.[2]

The effectiveness and accuracy of CBCT in diagnosing, planning treatment, making decisions, and assessing treatment outcomes for periodontal diseases are still unclear. Given the potential for higher radiation exposure, it's important to evaluate whether CBCT provides clinically relevant additional information. As a result, we conducted a systematic review to examine the efficacy of CBCT in periodontal diseases.

REVIEW

This literature review was conducted using an electronic database search method via Google Scholar. The keywords used were 'CBCT related to periodontal disease’. The inclusion criteria included journal articles published between 2019 and 2024. Articles were selected and filtered based on publication year, relevance to the topic, and research quality, resulting in 10 journal articles used in this review.

PERIODONTAL DISEASE

Periodontal disease is an inflammatory condition affecting both soft and hard periodontal structures. It begins as gingivitis, a mild and self-limiting inflammation.[5] Periodontal diseases are widespread in both developed and developing countries, impacting approximately 20–50% of the global population. Several risk factors contribute to the development of these diseases, including diabetes, smoking, genetic predisposition, stress, certain medications, and other influences. Recent research has highlighted a strong connection between periodontal disease and conditions such as cardiovascular disease, diabetes, and complications during pregnancy.[3] According to the US National Institute of Dental and Craniofacial Research, periodontal disease is an infection that affects the tissues supporting the teeth. It is primarily caused by poor oral hygiene, which leads to plaque buildup that eventually hardens into calculus. A study by the Dental Health Foundation of Ireland describes gingivitis as inflammation of the gum margins, resulting in redness, swelling, and bleeding when brushing.[6] Gingivitis can be acute, linked to infections, microorganisms, or trauma, or chronic, caused by bacterial biofilm accumulating on the teeth and gums. If left untreated, it can progress to periodontitis, which affects the bone and supporting tissues, leading to pocket formation between the teeth and gums. While most adults experience gingivitis, it does not always develop into periodontal disease. However, periodontitis is often a silent condition, becoming noticeable only when irreversible damage has occurred. Symptoms may include bleeding gums while brushing, loose teeth while eating, bad breath, and other signs in advanced stages. Regular dental check-ups are necessary for diagnosis, and while treatment can slow disease progression, the damage is often permanent.[7] If untreated, it progresses to periodontitis, a microbially-driven, host-mediated inflammation that leads to loss of periodontal attachment.

The 2017 World Workshop on Periodontal and Peri-Implant Diseases defined periodontitis diagnosis based on clinical attachment loss (CAL), measured around the erupted teeth using standardized probes. Periodontitis can be classified into three forms: periodontitis, periodontitis associated with systemic diseases, and necrotizing periodontitis. If left untreated, the disease can lead to severe complications, including deep periodontal lesions, bone and tooth loss, and masticatory dysfunction.[5] The severity of periodontal disease varies based on bacterial virulence and an individual’s immune response, which is influenced by genetic and environmental factors. Systemic conditions such as diabetes, leukemia, and Down syndrome can also contribute to disease severity, along with lifestyle factors like smoking and stress. Another related condition, peri-implantitis, is a complication of dental implants that affects their long-term success, with an estimated prevalence of 10% of implants and 20% of patients within 5–10 years after placement. Periodontitis is the second most common dental disease after tooth decay, affecting 30–50% of the US population, though only about 10% of cases are severe. Growing evidence suggests a link between periodontal disease and systemic health issues, including Alzheimer’s, cancer (particularly pancreatic cancer), respiratory diseases, diabetes, hypertension, and atherosclerosis. The connection between gum disease and heart attacks may stem from bacteria entering the bloodstream and spreading to organs such as the heart, lungs, and even the reproductive system, potentially contributing to conditions like erectile dysfunction.[6]

DIAGNOSIS OF PERIODONTAL DISEASE BY RADIOGRAPHY

Intraoral radiographs, such as periapical and bitewing images, are the most commonly used tools for periodontal assessment, offering clear visualization of teeth, alveolar bone, and periodontal ligament space with minimal radiation. Digital receptors like phosphor storage plates (PSP) and solid-state detectors have improved efficiency by reducing radiation exposure without compromising accuracy. While bitewing radiographs are effective for detecting bone loss in mild cases, vertical bitewings and periapical radiographs provide a more comprehensive assessment for deeper pockets. However, intraoral radiographs have limitations, including difficulty visualizing buccolingual bone loss and underestimating early-stage alveolar bone resorption.[8]

Panoramic radiography provides a broad view of dental structures with low radiation exposure, but its diagnostic reliability is limited due to distortion, magnification errors, and anatomical superimposition. Recent advancements, such as tomosynthesis and extraoral bitewing radiographs (EBR), aim to improve diagnostic accuracy. However, intraoral radiographs remain superior for precise periodontal assessment, while panoramic imaging serves as a supplementary tool.[8]

CBCT, introduced in the late 1990s, offers 3D imaging that overcomes the limitations of traditional 2D radiographs. It provides high sensitivity (80–100%) in detecting periodontal bone defects and is particularly useful for complex cases and implant planning. However, CBCT is not recommended for routine periodontal assessment due to concerns about radiation exposure, cost, and image artifacts from metal restorations. While it enhances diagnostic accuracy, clinicians must carefully balance its benefits against potential limitations when selecting an imaging modality.[8]

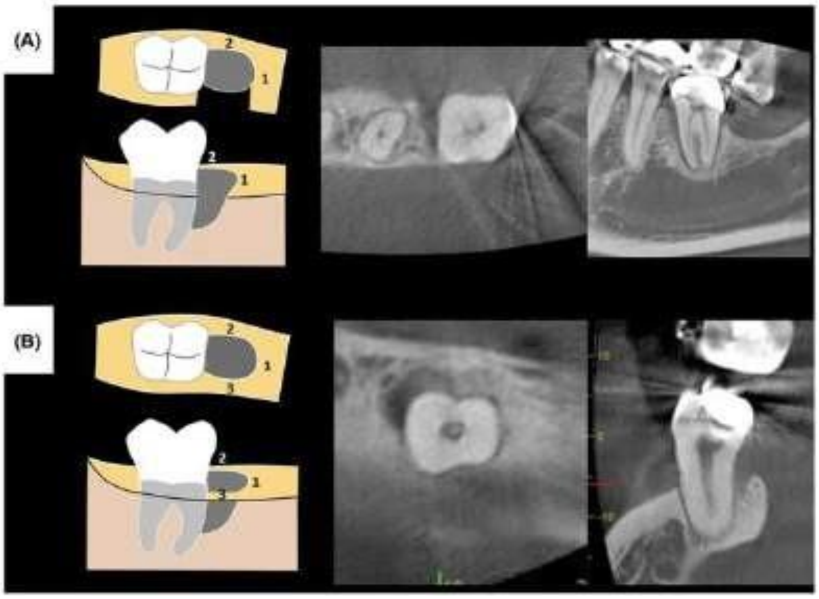

Figure 1. Cone beam computed tomography images illustrating complex vertical bone defects with 2-wall involvement (A) and 3-wall involvement (B) according to Jacobs et al. (Illustrations with courtesy of Dr Cascante-Sequeira).

RADIOGRAPHIC IMAGE QUALITY INDICATORS

Accurate radiographic interpretation relies on high-quality images, assessed through visual factors (detail, contrast, and density) and geometric factors (magnification, unsharpness, and distortion). Key determinants of image quality include contrast, blur, noise, artifacts, and distortion, all of which influence diagnostic accuracy. Contrast enhances visibility by differentiating adjacent structures, while blurring reduces clarity, limiting the detection of minor pathologies. Noise introduces graininess, artifacts create misleading image features, and distortion affects the accuracy of structural representation. CBCT provides superior imaging precision compared to conventional CT, which is hindered by lower resolution, longer scan times, and interpretation challenges. With its ability to generate high-resolution images, CBCT offers significant advantages in oral and maxillofacial imaging.[9]

CONE BEAM COMPUTED TOMOGRAPHY

Cone Beam Computed Tomography (CBCT) is an advanced imaging system that provides precise three-dimensional (3D) radiographic images. It offers high-resolution imaging (2 line pairs/mm) with a short scan time of approximately 60 seconds while maintaining excellent diagnostic quality. Compared to conventional CT, CBCT significantly reduces radiation exposure—delivering a dose nearly 10 times lower (68 µSv vs. 600 µSv for maxillofacial scans) while maintaining a dimensional accuracy within 2% magnification. Utilizing a conical X-ray beam and a solid-state panel detector, CBCT captures a complete anatomical volume in a single 180–360-degree rotation around the patient. Unlike conventional CT, which acquires section-by-section images, CBCT collects comprehensive volumetric data in a single scan, further minimizing radiation exposure.[10,11]

ROLE OF CBCT IN PERIODONTICS

A comprehensive periodontal assessment, along with a full-mouth radiographic series, remains essential for diagnosing periodontal conditions. However, CBCT scans can provide more precise measurements of alveolar bone height and morphology, improving diagnostic accuracy. The decision to use CBCT should be made on a case-by-case basis, as the increased radiation exposure may not be justified for all patients.[12] Research by Misch et al. found that CBCT is capable of providing a clearer three-dimensional image compared to conventional periapical radiography. This allows for more accurate detection of radiolucent lesions, root perforations, and bone resorption that may not be clearly visible in 2D imaging.[13] Similarly, CBCT visualized all bony craters and furcation defects, while conventional bitewing and periapical radiographs identified only 56% to 71% of discrepancies.[14] Comparable sensitivity was observed between CBCT and intraoral radiographs in detecting experimental defects, including dehiscences, fenestrations, and furcation involvement.[15] CBCT can reveal bony abnormalities that might be overlooked in routine clinical and radiographic assessments. However, there is limited evidence supporting its ability to improve short- and long-term periodontal treatment outcomes.[16]

DISCUSSION

Table 1. Articles included in this study

Authors (Year)	Title	Objective	Findings and Conclusion
Clemens Walter, Julia C. Schmidt, Carin A. Rinne, Silwan Mendes, Karl Dula, Anton Sculean (2020)	Cone beam computed tomography (CBCT) for diagnosis and treatment planning in periodontology: systematic review update	The aim of the present systematic review was to update the best available external evidence for the diagnostic accuracy and potential benefits of dental CBCT in periodontal diagnosis and treatment planning	This updated review provides clear evidence for CBCT imaging in detecting interfurcal, vertical, and horizontal bone loss. With respect to the teeth and sites analyzed, the benefit of CBCT imaging varies and is particularly pronounced in maxillary molars.
Ruhi Mark, Ranjana Mohan, M Gundappa, M. D. Saravana Balaji, V. K. Vijay, M. Umayal (2021)	Comparative evaluation of periodontal osseous defects using direct digital radiography and cone beam computed tomography	The aim of this study is to evaluate and compare the accuracy of direct digital radiography (DDR) and cone-beam computed tomography (CBCT) in the determination and diagnosis of periodontal osseous defects	This review confirmed that accurate evaluation could be achieved on CBCT for the infrabony defects and other osseous defects compared to DDR images. The 3D CBCT measurement of horizontal furcation involvement was precisely detected in the horizontal furcation involvement measurements on the buccal and lingual osseous defects, and trifurcations of maxillary molars.
Jingmei Yang, Xinyi Li, Dingyu Duan, Lin Bai, Lei Zhao, Yi Xu (2019	Cone-beam computed tomography performance in measuring periodontal bone loss	The aim of the present study was to evaluate the accuracy of CBCT and explore the differences between CBCT measurements and other methods of periodontal examinations	CBCT provides a useful noninvasive method for assessing periodontal bone loss, offering three-dimensional imaging with relatively high accuracy. However, CBCT measurements showed statistically significant differences compared to intra-surgical evaluations, which are considered the gold standard. While CBCT is beneficial for evaluating alveolar bone levels, it may underestimate bone loss, particularly in certain anatomical regions. The study highlights that CBCT should be used cautiously in periodontal diagnosis and treatment planning, complementing rather than replacing clinical and intra-surgical assessments.

Authors (Year)	Title	Objective	Findings and Conclusion
Maurice Ruetters, D. Hagenfeld, N. ElSayed, N. Zimmermann, H. Gehrig, T-S. Kim (2019)	Ex vivo comparison of CBCT and digital periapical radiographs for the quantitative assessment of periodontal defects	The aim of this study was to investigate the accuracy of CBCT and PA compared to the clinical situation in the cadavers and to assess the additional benefit of CBCT compared to PA	CBCT had higher agreement and less deviation than PAs, and CBCT itself seems to be an accurate method to detect and describe vertical periodontal bone loss. It should be seen as a valid additional diagnostic method, which can help to measure bony defects more accurately. Therefore, it could possibly better predict the success of regenerative therapy.
Syurri Innaddinna Syahraini, Hanna Huzaima Bachtiar Iskandar, Bramma Kiswanjaya, Fatimah Maria Tadjoedin (2023)	Correlation of clinical and radiographic severity of periodontitis with furcation involvement: evaluation of periapical radiographs and cone beam computed tomograpghy	The aim of this study was to analyze the correlation of clinical and radiographic features in periodontitis with furcation involvement	There was no correlation between periapical radiographs and CBCT. The correlation is only seen between periapical radiographs and CBCT.
Xue Zhang, Yuchao Li, Ziming Ge, Haijiao Zhao, Lei Miao, Yaping Pan (2020)	The dimension and morphology of alveolar bone at maxillary anterior teeth in periodontitis: a retrospective analysis—using CBCT	The objectives of this study were to measure the morphology of the maxillary alveolar bone in periodontitis patients and evaluate the differences in the dimensions between periodontitis patients and healthy individuals in order to investigate the distribution of alveolar bone defects and guide clinical practice	This study demonstrates that CBCT is a valuable tool for evaluating alveolar bone morphology in periodontitis patients, particularly in the maxillary anterior region. The findings indicate that as bone loss progresses, buccal residual bone thickness increases, while buccal undercuts and fenestrations decrease. CBCT provides detailed imaging that aids in diagnosing alveolar defects, assessing bone dimensions, and guiding clinical decisions for procedures like implant placement and periodontal surgeries.
V. Thomas Eshraghi, Kyle A. Malloy, and Mehrnaz Tahmasbi (2019)	Role of Cone-Beam Computed Tomography in the Management of Periodontal Disease	It aims to assess CBCT's accuracy in measuring alveolar bone height and morphology, its advantages over conventional radiographic techniques, and its potential to improve periodontal diagnosis and treatment outcomes	CBCT shows promise in periodontal diagnosis, but no evidence-based guidelines exist for its routine use. Limited FOV CBCT may be beneficial in select cases, but further research is needed to standardize imaging protocols. Until then, its use remains at the clinician's discretion, following the ALARA principle.
Hassan Assiri, Ali Azhar Dawasaz, Ahmad Alahmari, Zuhair Asiri (2020)	Cone beam computed tomography (CBCT) in periodontal diseases: a Systematic review based on the	The aim of this study was to address the diagnostic efficacy of cone-beam computed tomographic (CBCT)	CBCT provides detailed 3D imaging, enabling accurate evaluation of residual bone thickness, buccal undercuts, fenestrations,

Authors (Year)	Title	Objective	Findings and Conclusion
	efficacy model	imaging in periodontics based on a systematic search and analysis of the literature using the hierarchical efficacy model	and apical bone height. Overall, CBCT serves as a valuable diagnostic tool, offering critical information for personalized treatment planning in periodontal surgery and regenerative therapy.
M Mashyakhy, M Alkahtany (2021)	Prevalence of Apical Periodontitis between Root Canal-Treated and Non-Treated Teeth and Between Genders: A Cross-Sectional CBCT Study	The aim of the present study was to investigate the overall prevalence of AP among all permanent teeth, the differences root canal-treated (RCT) and non-treated teeth in association with AP, and the influence of gender on AP in a Saudi Arabian population using cone-beam computed tomography (CBCT)	CBCT is a valuable imaging tool for evaluating periodontal bone loss, providing detailed 3D visualization and improved accuracy over conventional 2D methods. However, it tends to underestimate bone loss compared to clinical attachment level (CAL) and intra-surgical measurements, which are considered the gold standard. Limitations such as voxel size, difficulty detecting thin structures, and artifacts from metallic restorations affect its accuracy. While CBCT can complement other diagnostic methods, its higher radiation dose requires careful consideration, ensuring it is used selectively and only when clinically necessary.
Ralf Schulze, Emilio Couso-Queiruga, Christos Katsaros (2024)	Accuracy of cone-beam computed tomography in imaging the components of the periodontal phenotype	This review addresses the underlying technical information for the use of CBCT scans, and suggests some recommendations on how to optimally use it despite its system-inherent limitations	CBCT is a valuable imaging modality for evaluating hard and soft tissue components of the periodontal phenotype. However, its accuracy in capturing small structures, such as thin gingival tissues and bone layers, is constrained by technical and anatomical limitations. For thin periodontal phenotypes, the lack of visible structures on CBCT does not necessarily indicate their actual absence. Combining CBCT with techniques like optical scanning or ultrasonography may improve diagnostic accuracy, but these methods also have limitations. Therefore, CBCT should be used judiciously in clinical practice, considering its strengths and inherent constraints.

The optimal approach for diagnosing periodontal diseases consists of a comprehensive full-mouth periodontal examination, incorporating both clinical and radiographic evaluations. This method enables precise detection and assessment of periodontal conditions. Periodontal probing plays a crucial role in clinical assessments, measuring probing depth (PD), clinical attachment level (CAL), bleeding on probing (BOP), mobility, and furcation involvement, all of which are key indicators of periodontal health.[3] Radiographic evaluations complement clinical findings by assessing alveolar bone levels and detecting osseous defects. Intraoral radiographs, such as periapical and bitewing images, provide detailed views of bone loss patterns.[3] Panoramic radiographs offer a broader perspective of the dentition. While traditional radiographic methods remain standard, advancements like Cone-Beam Computed Tomography (CBCT) have emerged. CBCT enhances diagnostic accuracy by offering three-dimensional visualization of periodontal structures, allowing for detailed evaluations of bone morphology and osseous defects.

All articles considered for the study are shown in Table 1. Walter et al (2020) found that CBCT provides more precise measurements of bone loss, furcation involvement, and periodontal defects compared to traditional 2D radiography, enhancing diagnostic accuracy. Its ability to improve visualization of anatomical structures makes it particularly useful for complex cases such as implant planning and guided surgeries. Additionally, CBCT is more effective in detecting both vertical and horizontal bone loss, especially in maxillary molars. However, despite its superior imaging capabilities, the higher radiation dose compared to standard X-rays remains a concern, necessitating a careful risk-benefit assessment before its use.[17]

The study by Mark et al (2021) measured the defects through surgical exposure, which is considered the gold standard. The study aimed to compare the accuracy of CBCT and Direct Digital Radiography (DDR) in diagnosing and measuring periodontal osseous defects by comparing their measurements with surgical exposure, which served as the gold standard. The results revealed that while DDR measurements showed notable differences from surgical findings, CBCT provided values that closely matched intra-surgical assessments, demonstrating higher accuracy in detecting and quantifying osseous defects. One of the key advantages of CBCT highlighted in this study was its superior ability to visualize furcation involvement and various osseous defect types, including one-wall, two-wall, three-wall, and four-wall defects. Due to its two-dimensional (2D) nature, DDR was unable to measure horizontal furcation involvement, whereas CBCT's three-dimensional (3D) imaging allowed for precise evaluation of both horizontal and vertical furcation defects. Additionally, CBCT was found to be more effective in detecting buccal and lingual osseous defects, as well as trifurcations in maxillary molars, further proving its diagnostic superiority. However, despite its advantages, CBCT comes with a higher radiation dose compared to DDR, necessitating its judicious use in clinical practice while adhering to the ALARA (As Low As Reasonably Achievable) principle to minimize radiation exposure.[2]

The study conducted by Yang et al (2019) revealed that CBCT tends to underestimate bone loss when compared to intra-surgical evaluations and CAL. Significant statistical differences were noted between CBCT and CAL + 2.04 mm (P = 0.000), as well as between CBCT and intra-surgical assessments (P = 0.001), indicating that CBCT may not always deliver precise measurements of alveolar bone loss. However, these discrepancies were less pronounced at buccal sites, where the differences were not statistically significant. Although CBCT has limitations in measurement accuracy, it remains a valuable diagnostic tool, particularly for its ability to enhance visualization of bone morphology and periodontal structures. Nonetheless, the study underscores that CBCT should not serve as a substitute for clinical or intra-surgical assessments but should instead complement them in periodontal diagnosis and treatment planning. Given its higher radiation exposure, clinicians must carefully assess its necessity, ensuring its use is warranted for cases requiring detailed bone evaluation.[18]

Ruetters et al (2019) revealed that CBCT demonstrated greater accuracy and consistency in assessing periodontal bone loss compared to PA. The mean absolute difference between CBCT and clinical measurements was 0.9 mm ± 0.9 SD, while PA had a larger discrepancy of 1.5 mm ± 1.5 SD. One of the main advantages of CBCT is its ability to generate three-dimensional images of periodontal defects, enabling a more detailed and accurate evaluation of buccal and lingual bone loss. In contrast, PA, due to its two-dimensional nature, often failed to detect these defects effectively. Notably, PA was particularly inadequate in assessing horizontal bone loss, emphasizing a significant limitation compared to CBCT. The study also revealed that CBCT's accuracy varied depending on tooth location. It was more dependable in evaluating posterior teeth (molars and premolars) than anterior teeth, likely due to differences in bone structure and the thinner buccal bone in the anterior region. Clinically, CBCT serves as a valuable diagnostic tool for identifying periodontal bone loss, furcation involvement, and osseous defects, making it especially beneficial in cases that require precise bone measurements for treatment planning and regenerative periodontal procedures. However, the study also highlights CBCT's higher radiation exposure compared to PA, stressing the importance of careful consideration and justification for its use based on the patient's specific diagnostic requirements.[4]

Syahraini et al (2023) examined the relationship between clinical and radiographic evaluations of furcation involvement in periodontitis patients using periapical radiographs and cone-beam computed tomography (CBCT). The results showed notable differences between clinical and radiographic assessments, highlighting inconsistencies in detecting furcation involvement across various methods. CBCT emerged as the most precise imaging technique, especially in severe cases of Grade 2 and 3 furcation defects. A strong positive correlation was identified between periapical radiographs and CBCT findings, indicating that furcation involvement observed in periapical radiographs was often confirmed by CBCT. In summary, the study confirmed that CBCT is the most effective imaging modality for evaluating furcation involvement in periodontitis, providing enhanced three-dimensional visualization compared to periapical radiographs and clinical examination. Periodontal probing was limited in detecting deep furcation defects, particularly when buccal or lingual bone remained intact. Likewise, periapical radiographs struggled to identify bone destruction in buccal and lingual areas due to overlapping anatomical structures. Conversely, CBCT's three-dimensional imaging allowed for a more precise evaluation of bone loss and furcation defects.[19]

Research by Zhang et al (2020) emphasized the crucial role of Cone-Beam Computed Tomography (CBCT) in evaluating alveolar bone morphology in the maxillary anterior region of periodontitis patients. By providing detailed three-dimensional imaging, CBCT allowed for a more precise assessment of buccal and lingual bone thickness, apical bone height, and alveolar defects such as fenestrations and undercuts. Compared to conventional radiographic methods, CBCT proved to be more effective in detecting subtle bone changes essential for periodontal diagnosis and treatment planning. A key finding of the study was that CBCT enabled accurate measurement of bone thickness, showing that periodontitis patients exhibited increased buccal residual bone thickness but decreased palatal bone thickness compared to healthy individuals. Additionally, CBCT identified variations in apical bone height, which correlated with both age and the severity of bone loss. The study also demonstrated CBCT's ability to clearly classify different sagittal root positions, a crucial aspect in implant planning and periodontal procedures to minimize risks such as bone perforation.[20]

The findings of Eshraghi et al (2019) indicate that CBCT was more effective than intraoral radiographs (IOR) in detecting furcation involvement and intrabony defects. Specifically, CBCT accurately identified 99.7% of intrabony defects and 94.8% of furcation involvements, whereas IOR had considerably lower detection rates. The study also emphasized the clinical significance of CBCT in periodontal management. By offering detailed assessments of bone morphology, dehiscences, and fenestrations, CBCT plays a crucial role in treatment planning for regenerative procedures, implant placement, and periodontal surgeries. Furthermore, it enhances post-surgical evaluation, minimizing the need for invasive re-entry procedures to assess treatment outcomes. Although CBCT provides significant advantages, the study noted that it should not yet be regarded as the standard diagnostic tool for periodontal assessment. Instead, its application should be determined by clinical necessity, particularly in cases where conventional radiographic methods do not provide sufficient information.[3] A study by Assiri et al (2020) emphasized that CBCT offered enhanced three-dimensional imaging compared to conventional intraoral radiographs, enabling more accurate evaluations of periodontal conditions. It proved especially useful in identifying intrabony defects and furcation involvement, making it a valuable tool for complex cases where traditional diagnostic methods may be inadequate. The study concluded that while CBCT serves as a beneficial supplementary tool in periodontal diagnosis and treatment planning, particularly for advanced cases requiring detailed imaging, its application should be determined by clinical necessity. It should not yet be regarded as the standard diagnostic approach for all periodontal cases.[1]

The research carried out by Mashyakhy et al (2021) indicated that the overall prevalence of apical periodontitis (AP) was 4.5%, with the highest occurrence found in mandibular and maxillary first molars at 18.4% and 9.3%, respectively. CBCT analysis revealed that AP was significantly more prevalent in root canal-treated teeth, representing 66.3% of cases, whereas non-treated teeth accounted for 33.7%. This correlation between AP and endodontically treated teeth was statistically significant ($P < 0.001$). Additionally, although AP was observed more frequently in females than in males, the difference was not statistically significant ($P > 0.05$). CBCT proved to be highly effective in detecting AP, particularly in cases where conventional radiographs might fail to identify lesions, such as those confined to cancellous bone. The study underscored the necessity of meticulous radiographic evaluation, particularly in root canal-treated teeth, to prevent undiagnosed AP cases. While CBCT enhanced diagnostic accuracy, its routine implementation should be carefully considered, balancing the benefits with potential radiation exposure risks.[21]

Schulze et al (2024) evaluated the accuracy of Cone-Beam Computed Tomography (CBCT) in capturing various aspects of the periodontal phenotype, including alveolar bone thickness, gingival thickness, and supracrestal tissue dimensions. The results indicated that CBCT offers valuable three-dimensional imaging of periodontal structures, making it particularly beneficial for assessing bone morphology and aiding in treatment planning across periodontology, orthodontics, and implantology. However, multiple factors impact CBCT's precision, such as patient movement, voxel size, metallic artifacts, and soft tissue overlap. These challenges are especially significant when imaging thin structures like the buccal and lingual bony layers of incisors, potentially leading to overestimation or underestimation of alveolar bone thickness. The study also highlighted the need to acknowledge CBCT's inherent limitations, particularly in evaluating thin periodontal phenotypes where small anatomical structures may not be accurately visualized. The absence of a visible bone or soft tissue layer on CBCT scans does not necessarily indicate its actual absence but may be a result of imaging constraints. Consequently, clinicians should carefully interpret CBCT images and, when needed, incorporate additional diagnostic methods to ensure comprehensive evaluations.[22]

CONCLUSION

CBCT plays a crucial role in diagnosing periodontal disease by providing superior three-dimensional imaging compared to conventional radiographs. It enhances the detection of bone loss, furcation involvement, and intrabony defects, making it valuable for complex cases such as implant planning and guided surgeries. Studies show CBCT is more accurate in assessing alveolar bone morphology and detecting vertical and horizontal bone loss. However, its limitations include potential overestimation or underestimation of bone thickness due to voxel size, artifacts, and soft tissue overlap. Additionally, its higher radiation dose requires careful clinical consideration. While CBCT is a useful adjunct in periodontal diagnosis and treatment planning, it should be used selectively, ensuring its benefits outweigh radiation risks and following the ALARA principle.

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FOOTNOTES

All authors have no potential conflict of interest to declare for this article.

REFERENCES

1. Assiri H, Dawasaz AA, Alahmari A, Asiri Z. Cone beam computed tomography (CBCT) in periodontal diseases: a Systematic review based on the efficacy model. BMC Oral Health. 2020;20(1):191. doi: 10.1186/s12903-020-01106-6
2. Mark R, Mohan R, Gundappa M, Balaji MDS, Vijay VK, Umayal M. Comparative Evaluation of Periodontal Osseous Defects Using Direct Digital Radiography and Cone-Beam Computed Tomography. J Pharm Bioallied Sci. 2021;13(Suppl 1):306-311. doi: 10.4103/jpbs.JPBS_804_20
3. Eshraghi VT, Malloy KA, Tahmasbi M. Role of cone-beam computed tomography in the management of periodontal disease. Dent J. 2019;7(2):57. doi: 10.3390/dj7020057
4. Ruetters M, Hagenfeld D, ElSayed N, Zimmermann N, Gehrig H, Kim TS. Ex vivo comparison of CBCT and digital periapical radiographs for the quantitative assessment of periodontal defects. Clin Oral Invest. 2020;24(1):377-84. doi: 10.1007/s00784-019-02933-w
5. Nocini R, Lippi G, Mattiuzzi C. Periodontal disease: the portrait of an epidemic. J Pub Health Emergency. 2020;25(4):10. doi: 10.21037/jphe.2020.0
6. Mann J, Bernstein Y, Findler M. Periodontal disease and its prevention, by traditional and new avenues. Exp Ther Med. 2020;19(2):1504-1506. doi: 10.3892/etm.2019.8381
7. Chapple ILC et al. Periodontal health and gingival diseases and conditions on an intact and a reduced periodontium: consensus report of workgroup 1 of the 2017 world workshop on the classification of periodontal and peri-implant diseases and conditions. J Periodontol. 2018;89(1):74-84. doi: 10.1002/JPER.17-0719
8. Jacobs R, Fontenele RC, Lahoud P, Shujaat S, Bornstein MM. Radiographic diagnosis of periodontal diseases–Current evidence versus innovations. Periodontol 2000. 2024;95(1):51-69. doi: 10.1111/prd.12580
9. Agung AA, Anggreni NK. The effectivity of cone beam computed tomography (CBCT) in dentigerous cyst management: a literature review. J Radio Dentomaks Indo. 2022;6(2):73-80. doi: https://doi.org/10.32793/jrdi.v6i2.888
10. Kumar M, Shanavas M, Sidappa A, Kiran M. Cone beam computed tomography - know its secrets. J Int Oral Health. 2015;7(2):64-8
11. Venkatesh E, Elluru SV. Cone beam computed tomography: basics and applications in dentistry. J Istanb Univ Fac Dent. 2017;51(3 Suppl 1):102-121. doi: 10.17096/jiufd.00289
12. McAllister BS, Eshraghi VT. Commentary: Cone-Beam Computed Tomography: An Essential Technology for Management of Complex Periodontal and Implant Cases. J Periodontol. 2017;88(10):937-938. doi: 10.1902/jop.2017.1710001
13. Kurniati N, Azhari. Evaluasi diagnostik lesi-endo perio yang menetap setelah perawatan endodontik menggunakan radiografi periapikal dan cbct. JITEKGI. 2019;15(1):6-11
14. Dehghani M, Moeini M, Bardal R. Comparing the accuracy of cone beam computed tomography, digital intraoral radiography and conventional intraoral radiography in the measurement of periodontal bone defects. J Res Dent Maxillofac Sci. 2016;1(1):34-39
15. Lee S, Lee K, Kim H, An J, Han J, Lee T, Jeong H, Cho Y. Comparison of dental radiography and computed tomography: measurement of dentoalveolar structures in healthy, small-sized dogs and cats. Journal of veterinary science. 2020;21(5):75
16. Kim DM, Bassir SH. When is cone-beam computed tomography imaging appropriate for diagnostic inquiry in the management of inflammatory periodontitis? an american academy of periodontology best evidence review. J Periodontol. 2017;88(10):978–998. doi: 10.1902/jop.2017.1710001
17. Walter C, Schmidt JC, Rinne CA, Mendes S, Dula K, Sculean A. Cone beam computed tomography (CBCT) for diagnosis and treatment planning in periodontology: systematic review update. Clin Oral Investig. 2020;24(9):2943-2958. doi: 10.1007/s00784-020-03326-0
18. Yang J, Li X, Duan D, Bai L, Zhao L, Xu Y. Cone-beam computed tomography performance in measuring periodontal bone loss. J Oral Sci. 2019;61(1):61-66. doi: 10.2334/josnusd.17-0332
19. Syahraini SI, Iskandar HHB, Kiswanjaya B, Tadjoedin FM. Correlation of clinical and radiographic severity of periodontitis with furcation involvement: evaluation of periapical radiographs and cone-beam computed tomography. J Radio Dentomaks Indo. 2023;7(2):47-52. doi: https://doi.org/10.32793/jrdi.v7i2.1070
20. Zhang X, Li Y, Ge Z, Zhao H, Miao L, Pan Y. The dimension and morphology of alveolar bone at maxillary anterior teeth in periodontitis: a retrospective analysis using CBCT. Int J Oral Sci. 2020;12(1):4. doi: 10.1038/s41368-019-0071-0
21. Mashyakhy M, Alkahtany M. Prevalence of apical periodontitis between root canal-treated and non-treated teeth and between genders: A cross-sectional CBCT study. Niger J Clin Pract. 2021;24(11):1656-1661. doi: 10.4103/njcp.njcp_627_20
22. Schulze R, Couso-Queiruga E, Katsaros C. Accuracy of cone-beam computed tomography in imaging the components of the periodontal phenotype. Periodontol 2000. 2024;36(1):64-72. doi: 10.1111/prd.12556