

The value of Cone Beam Computed Tomography (CBCT) in modern dentistry

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Abstract

Cone Beam Computed Tomography (CBCT) has become an essential diagnostic tool in contemporary dentistry. By providing high-resolution, three-dimensional (3D) visualization of maxillofacial structures, CBCT bridges the gap between conventional radiography and advanced digital diagnostics. Its value extends across implantology, endodontics, orthodontics, oral surgery, and periodontics—supporting precision treatment and ethical patient care.

1. Diagnostic Precision

CBCT overcomes the limitations of two-dimensional imaging by eliminating distortion and anatomical overlap. It allows clinicians to accurately localize pathologies, evaluate alveolar bone and root morphology, and visualize structures such as the temporomandibular joint and paranasal sinuses. The enhanced diagnostic detail supports early detection and more targeted treatment planning.^{1,2,6,7,8}

2. Implant Dentistry

In implantology, CBCT is indispensable for assessing bone volume, density, and anatomical constraints. It enables precise localization of vital structures such as the inferior alveolar nerve and maxillary sinus. Virtual implant planning and guided surgical workflows based on CBCT data improve accuracy, predictability, and patient safety.^{1,2,6,8}

3. Endodontics

CBCT enhances endodontic diagnosis and management by revealing complex root canal anatomy, root fractures, and periapical lesions that may not be visible on periapical radiographs. Three-dimensional imaging supports differentiation between cystic and granulomatous lesions and aids in evaluating treatment outcomes and post-operative healing.^{2,3,4,7,8,9}

4. Oral and Maxillofacial Surgery

For surgical interventions, CBCT provides comprehensive pre-operative assessment and post-operative evaluation. It facilitates the management of impacted teeth, cysts, tumors, and fractures, as well as orthognathic and reconstructive surgery through 3D cephalometric analysis and volumetric evaluation.^{2,4,6,8}

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5. Orthodontics and Airway Analysis

In orthodontics, CBCT contributes to growth assessment, treatment planning (cephalometric assessment), treatment simulation, and airway evaluation. It assists in detecting impacted teeth, root resorption, and skeletal discrepancies, supporting digital model creation and precise appliance design. Additionally, airway volume and morphology can be accurately measured, contributing to the diagnosis and management of obstructive sleep apnea.^{5,6,8,9}

6. Periodontics

CBCT imaging allows detailed assessment of alveolar bone morphology, intrabony defects, and furcation involvement.^{8,11}

7. Ethical and Safety Considerations

The diagnostic advantages of CBCT must be balanced with ethical imaging practices. The ALARA principle (As Low As Reasonably Achievable) should guide exposure protocols, with justified use, patient-specific field of view selection, and dose optimization. Interpretation should be performed by clinicians adequately trained in CBCT radiology to ensure diagnostic accuracy and patient safety.¹⁰

Conclusion

CBCT represents a paradigm shift toward precision, safety, and evidence-based care in modern dentistry. Its integration into clinical workflows enhances diagnostic confidence, treatment accuracy, and patient outcomes. When used responsibly, CBCT exemplifies the future of technologically guided, ethically responsible dental practice.

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