REVIEW ARTICLE

The Role and impact of Dental Assistants in CBCT (Cone Beam Computed Tomography) Imaging

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Received: 17-02-2025 **Accepted:** 23-04-2025 **Published:** 09-05-2025

ABSTRACT

Cone Beam Computed Tomography (CBCT) has transformed dental diagnostics by enabling high-resolution, three-dimensional imaging of maxillofacial structures. As CBCT becomes more prevalent across various dental specialties, the role of dental assistants has significantly expanded beyond traditional support functions. This review explores the responsibilities, competencies, training requirements, and ethical considerations for dental assistants involved in CBCT imaging. Through a synthesis of academic literature, regulatory guidelines, and current clinical practices, this paper emphasizes the growing need for standardized education, legal clarity, and interdisciplinary collaboration. Dental assistants, when properly trained, play a vital role in ensuring patient safety, image quality, and workflow efficiency in CBCT-supported dental care.

KEYWORDS: Cone Beam Computed Tomography (CBCT); Dental Assistants; Dental Radiography; Radiation Safety; Imaging Protocols; Patient Positioning; Dental Technology; Radiographic Competency; 3D Imaging; Oral Radiology.

INTRODUCTION

In recent decades, dental imaging has undergone significant advancements, driven by the increasing demand for more precise, three-dimensional (3D) diagnostic tools. One of the most significant innovations in this realm is Cone Beam Computed Tomography (CBCT), a technology that provides volumetric images of dental and maxillofacial structures with high spatial resolution and relatively low radiation exposure compared to conventional CT. Originally developed for angiography and other medical applications, CBCT has been successfully adapted for dental use, particularly in implant planning, endodontics, orthodontics, temporomandibular joint (TMJ) diagnostics, and maxillofacial surgery (1).

The implementation of CBCT in dental practices has necessitated not only technological upgrades but also a restructuring of clinical workflows. Dentists now rely on a broader team to manage the operational, technical, and patient care aspects of imaging. Among these team members, dental assistants play a pivotal role in supporting CBCT related tasks, ensuring both technical quality and patient comfort throughout the process. Their responsibilities have evolved from basic radiography support to include complex tasks like CBCT image acquisition, patient positioning, adherence to radiation safety protocols, and data management (2).

However, the extent of a dental assistant's role in CBCT imaging varies widely depending on national and regional regulations, as well as the level of formal training they have received. While in some jurisdictions, dental assistants may operate CBCT equipment under direct supervision after appropriate certification, in others, they are not permitted to do so unless they are licensed radiographers.

This review explores the multifaceted roles that dental assistants fulfill in CBCT imaging, with a focus on technical, clinical, legal, and ethical aspects. It also highlights the need for standardized training and certification protocols and discusses challenges and opportunities arising from the growing integration of advanced imaging technologies in dental care.

MATERIALS AND METHODS

This review was conducted using a narrative review methodology aimed at synthesizing existing literature on the role of dental assistants in CBCT imaging. Sources were selected based on relevance, scientific rigor, and publication within the last 15 years.

Data Sources and Search Strategy

A comprehensive search was performed using the following electronic databases:

- PubMed
- Google Scholar
- ScienceDirect
- Scopus

Search terms included:

"CBCT and dental assistants", "Cone Beam Computed Tomography in dentistry", "radiographic training for dental staff", "dental radiography scope of practice", and "ALARA in dental imaging". Boolean operators and truncation were used to expand results.

Inclusion and Exclusion Criteria

Inclusion criteria:

- Peer-reviewed journal articles and clinical guidelines.
- Studies and reviews discussing CBCT applications in dentistry.
- Documents outlining the scope of practice, training, and roles of dental assistants in imaging.

Exclusion criteria:

- Articles unrelated to dental imaging.
- Non-English publications.
- Outdated studies published prior to 2008 unless foundational.

Data Synthesis

Data were thematically categorized into:

- CBCT technical principles
- Clinical applications
- Assistant responsibilities
- Legal/ethical frameworks
- Training and certification

Expert opinion papers, guidelines from professional dental boards, and manufacturer documentation were also consulted to provide context and support to emerging themes.

DISCUSSION

The discussion around the role of dental assistants in CBCT imaging must take into account the complexity of the technology, the clinical setting, and the evolving landscape of dental diagnostics. CBCT imaging is not simply a matter of "pressing a button"; it requires an understanding of patient-specific imaging protocols, radiographic anatomy, radiation safety, and equipment calibration. Dental assistants are increasingly expected to contribute to all of these domains, often serving as the bridge between the technology and the clinician.

Importance of Specialized Training

One of the key implications of the shift toward CBCT-based diagnostics is the need for specialized training among dental assistants. Unlike conventional 2D radiography, CBCT requires a deeper understanding of patient positioning, exposure parameters, 3D data acquisition, and interpretation of axial, sagittal, and coronal planes. Although the primary interpretation of CBCT data is reserved for the dentist or oral radiologist, dental assistants often handle the image acquisition and initial data preparation, which requires accuracy and attention to technical detail (3).

Several studies have indicated that practitioners often lack full awareness of CBCT's appropriate indications and radiation dose implications, raising concerns about improper delegation or insufficient oversight. Thus, if DAs are to play an expanded role in CBCT imaging, robust continuing education programs and certification frameworks must be established to ensure competence and safety. For instance, in countries like the UK, IR(ME)R regulations define clear operator and practitioner responsibilities, requiring formal training and documentation for those handling CBCT equipment (4). Ensuring DAs meet these standards is crucial for legal and clinical safety.

Workflow Optimization and Clinical Efficiency

The impact of dental assistants on workflow efficiency when using CBCT is considerable. As dental clinics integrate high-tech diagnostic tools, clinicians increasingly rely on assistants to manage the technical and preparatory steps. By assuming responsibilities such as machine calibration, patient preparation, and scan acquisition, dental assistants streamline the clinical workflow, allowing dentists more time for diagnostics, treatment planning, and patient interaction. This division of labor improves overall productivity, reduces appointment duration, and enhances service delivery—particularly in high-volume practices or specialty settings such as implantology or oral surgery (5,6)

Furthermore, by managing CBCT-related tasks such as data transfer to PACS systems, backup protocols, and even initial scan triaging using artificial intelligence (AI) tools, DAs contribute to data management and clinical decision support . Their role is no longer passive but dynamic and technical, requiring knowledge of imaging software, file formats (e.g., DICOM), and 3D visualization techniques (6).

Radiation Safety and Legal Accountability

Another critical area in which DAs play a vital role is radiation protection. CBCT involves a higher radiation dose compared to traditional intraoral radiographs, although still significantly lower than medical CT. Ensuring the ALARA (As Low As Reasonably Achievable) principle is upheld requires careful selection of scan protocols, collimation, and justification for imaging. Dental assistants involved in CBCT operation must be trained in radiation biology, dose optimization techniques, and emergency shut-off procedures (7).

Failure to adequately train and supervise assistants in these areas may lead to non-compliance with radiological safety regulations, increased patient exposure, or legal liability for the practice. Notably, studies have pointed out that many dental practices fall short in documenting justification and dose optimization measures. Proper integration of DAs into radiation safety programs, including regular audits and dose monitoring, is essential for legal and ethical practice.

Challenges in Scope of Practice and Regulation

Despite the growing importance of DAs in CBCT imaging, significant variation exists in their legal scope of practice worldwide. In many regions, dental assistants may not be legally permitted to operate CBCT units or interpret data, regardless of their training. This restriction can hinder workflow efficiency and limit the utilization of competent assistants. On the other hand, overly broad delegation without adequate supervision can jeopardize patient safety and increase medico-legal risks (8).

Thus, national regulatory bodies must strike a balance between enabling task delegation and ensuring safety through licensing, training requirements, and scope-of-practice definitions. A unified framework across regions may also facilitate mobility and credential recognition for dental assistants who work in technologically advanced clinics.

The Role of Artificial Intelligence and Digital Tools

The integration of **AI-powered CBCT analysis** tools has begun to influence the way DAs contribute to diagnostics. These systems can assist with automatic segmentation, anatomical landmark recognition, and detection of common pathologies such as periapical lesions or impacted teeth (9). Dental assistants trained in using these tools can play a supporting role in pre-processing the data before clinician review, flagging poor-quality scans, and even generating preliminary reports for validation.

However, these capabilities must be approached cautiously. AI is not infallible, and reliance on unvalidated tools without clinical oversight could lead to missed or incorrect diagnoses. Therefore, training DAs to understand both the potential and limitations of AI systems is crucial to ensure they augment rather than compromise the diagnostic process.

Enhancing Patient Education and Experience

In addition to technical duties, DAs serve as crucial communicators with patients undergoing CBCT scans. Many patients are unfamiliar with 3D imaging or concerned about radiation risks. Dental assistants can address these concerns, explain the scan process, and use 3D visualizations to help patients understand their conditions and treatment options (9). This educational role contributes to greater patient satisfaction, increased trust in the practice, and improved adherence to treatment recommendations.

By making complex data accessible and engaging, DAs bridge the gap between advanced technology and patient comprehension. This patient-centered communication is especially valuable in practices where informed consent and shared decision-making are prioritized.

The Need for Ongoing Professional Development

The dynamic nature of CBCT technology necessitates lifelong learning. As software platforms become more sophisticated and integrate with broader digital workflows (e.g., CAD/CAM systems, digital impressions), dental assistants must pursue continuing education. Online training modules, manufacturer-sponsored workshops, and certification

programs are becoming essential components of professional development for dental assistants who wish to remain relevant and valuable in modern dental settings (10,11).

Opportunities and Future Directions

As dental practices move toward full digital integration, dental assistants with CBCT expertise will be in high demand. This shift presents opportunities for:

- **Career advancement** through specialization in radiology or digital workflows.
- **Increased autonomy** in tasks related to diagnostic support.
- **Enhanced interdisciplinary collaboration** with radiologists, orthodontists, and oral surgeons.

Moreover, AI tools in CBCT software may augment the assistant's capabilities in pre-screening images for quality and even flagging abnormalities, although final diagnostic interpretation remains the responsibility of the licensed dentist or radiologist.

The future of CBCT imaging is likely to include:

- Improved automation of scanning protocols.
- Remote image acquisition in teledentistry contexts.
- Integration with electronic health records (EHR) for seamless data sharing.

Dental assistants will play a pivotal role in this transformation, but only if they are adequately trained, supported, and legally empowered to do so.

CHALLENGES AND LIMITATIONS

- **Training & Competency**: Standard dental assistant training often does not include CBCT operation or interpretation skills. Additional radiography-specific certification is required.
- **Variability in Regulations**: In some jurisdictions assistants cannot legally perform CBCT exposures—even if trained—unless under supervision or in certain roles.
- **Knowledge Gaps**: Literature shows practitioners, and likely assistants too, often lack adequate understanding of -CBCT indications, radiation doses, and ALARA principles.
- **AI Limitations**: While promising, AI tools are still maturing; many studies highlight limited validation, possible bias, and need for annotated datasets

CHALLENGES AND LIMITATIONS

- **Structured Training Programs**: Incorporate CBCT-specific modules into DA curricula and continuing education (radiation physics, positioning, image evaluation, safety).
- **Clear Role Protocols**: Define roles—operator vs assistant—based on national regulation and ensure written protocols.
- **Regular QA & Safety Audits**: Assistants should take part in regular equipment calibration, exposure log review, and image quality assessment.
- **AI Adoption with Oversight**: Use AI tools for segmentation and artifact detection but maintain human oversight and validation.

Enhancing Patient Engagement: Train assistants in communication skills for explaining CBCT benefits, risks, and results.

CONCLUSION

The contribution of dental assistants to CBCT imaging is multifaceted, encompassing technical, regulatory, educational, and ethical dimensions. As dental practices become more reliant on advanced imaging, assistants will continue to play a vital role in ensuring that CBCT is implemented safely, efficiently, and ethically. However, to support this expanded role, structured training programs, clear legal frameworks, and appropriate supervision protocols are imperative. Additionally, as AI and digital tools become more prevalent, DAs will need ongoing education to adapt to evolving technological landscapes. Their effective involvement not only benefits clinical operations but also enhances the patient experience and contributes to high-quality care delivery.

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How to Cite: Alkhotani AA, Barnawi MA, Najmi AY1, Alsalloum AA.The Role and impact of Dental Assistants in CBCT (Cone Beam Computed Tomography) Imaging. *Radiol Med* 2025 May;19(2): 18-21.