REVIEW ARTICLE

Compliance and Role of Dental Assistants in Radiation Safety Protocols in Dental Clinics

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ABSTRACT

The use of ionizing radiation in dental practices for diagnostic imaging requires strict adherence to safety protocols to minimize exposure risks for both patients and healthcare providers. Dental assistants (DAs) play a critical role in implementing radiation safety measures and ensuring regulatory compliance. This review investigates the current state of compliance among dental assistants with radiation safety standards, explores their roles and responsibilities, and identifies factors influencing their knowledge, attitudes, and practices. Evidence suggests that while most dental assistants are aware of basic safety principles, gaps in training, inconsistent enforcement of protocols, and limited continuing education opportunities affect full compliance. The review underscores the need for standardized training, regular assessments, and institutional support to enhance the role of DAs in radiation protection. Recommendations are offered to improve practice standards and foster a culture of safety in dental clinics.

KEYWORDS: Dental Assistants, Radiation Safety, ALARA Principle, Dental Radiography, Occupational Exposure, Dental Clinics, Radiation Protection, Regulatory Guidelines

INTRODUCTION

Radiographic imaging is an indispensable tool in modern dentistry, allowing for the accurate diagnosis, treatment planning, and monitoring of oral and maxillofacial diseases. The use of ionizing radiation in dental radiography, including intraoral, panoramic, and cone-beam computed tomography (CBCT), is generally considered safe when applied appropriately. However, even small doses of ionizing radiation carry potential risks, especially with repeated exposure over time. The biological effects of radiation, though minimal per dental exposure, are cumulative, and improper use of radiographic equipment can pose health hazards not only to patients but also to dental healthcare personnel (1). Therefore, stringent radiation safety protocols are essential in clinical dental settings to protect both patients and practitioners.

Radiation safety in dentistry is governed by international and national regulatory bodies, such as the International Commission on Radiological Protection (ICRP), the International Atomic Energy Agency (IAEA), the U.S. Occupational Safety and Health Administration (OSHA), and country-specific dental regulatory authorities (2). These organizations have developed guidelines and regulations centered around key safety principles, most notably the ALARA principle ("As Low As Reasonably Achievable"), which aims to minimize unnecessary radiation exposure by optimizing radiographic practices. Proper implementation of these guidelines requires the active involvement of all members of the dental team, including dental assistants (DAs), who play a frontline role in facilitating radiographic procedures (3,4).

Dental assistants are often responsible for tasks such as patient preparation, equipment setup, positioning, radiation exposure, and ensuring the use of protective measures like lead aprons and thyroid collars. In some jurisdictions, DAs are certified to take radiographs independently under the supervision of licensed dentists. As such, they are not only technical support personnel but also key contributors to the maintenance of a safe radiographic environment. Despite their critical role, several studies have indicated that dental assistants may have inadequate knowledge of radiation protection protocols or demonstrate inconsistent adherence to safety measures (5,6).

Multiple factors contribute to this variability in compliance among dental assistants. These include differences in formal education and training, access to continuing education programs, institutional enforcement of safety protocols, availability of updated equipment, and overall safety culture within dental clinics. Inadequate supervision or lack of awareness about updated regulatory requirements may also affect their ability to follow best practices. Moreover, in busy dental settings, radiation safety measures may be overlooked in favor of workflow efficiency, increasing the risk of exposure to both patients and staff (7,8).

Given these concerns, it is imperative to assess and understand the level of compliance with radiation safety protocols among dental assistants. This includes evaluating their knowledge, attitudes, and practices related to radiographic procedures and identifying gaps that may exist in training or implementation. It is also important to explore how institutional policies, continuing education, and technological support can influence their ability to maintain radiation safety standards.

AIM

This scintific paper aims to synthesize current literature regarding the compliance of dental assistants with radiation safety protocols, evaluate their role in upholding safety standards, and highlight the factors that either support or hinder effective implementation. By identifying key challenges and proposing actionable recommendations, this review seeks to promote a culture of safety in dental clinics and reinforce the essential contribution of dental assistants in protecting public and occupational health.

MATERIALS AND METHODS

Study Design

This study is aimed at synthesizing current research findings on the compliance of dental assistants with radiation safety protocols and their role in promoting radiation protection in dental clinical settings. The review includes both qualitative and quantitative studies, as well as relevant policy and regulatory documents.

Literature Search Strategy

A comprehensive literature search was conducted across electronic databases PubMed/MEDLINE, Scopus, Google Scholar, ScienceDirect,Web of Science.

The search covered articles published between January 2010 and August 2025, to ensure the inclusion of the most relevant and recent evidence. Additional searches were performed using the websites of regulatory organizations such as:

- International Atomic Energy Agency (IAEA)
- International Commission on Radiological Protection (ICRP)
- U.S. Occupational Safety and Health Administration (OSHA)
- World Health Organization (WHO)
- National dental boards and health ministries

Search Terms

The following **keywords** and **Boolean** operators were used in various combinations:

- "Dental assistants" OR "dental auxiliaries"
- "Radiation safety" OR "radiation protection"
- "Dental radiography" OR "dental X-rays" OR "intraoral imaging"
- "Compliance" OR "adherence" OR "practice patterns"
- "ALARA" OR "radiation dose optimization"
- "Knowledge, attitude, and practice" OR "KAP"
- "Occupational radiation exposure"

Search strings were customized for each database. Articles were screened based on titles and abstracts, and duplicates were removed.

Inclusion Criteria

Studies were included if they met the following criteria:

- Focused on dental assistants, dental hygienists, or auxiliary staff involved in radiographic procedures
- Reported data on knowledge, compliance, training, or practice of radiation safety protocols
- Published in peer-reviewed journals in English
- Included primary data (e.g., surveys, interviews, observational studies) or were systematic/narrative reviews
- Covered both developed and developing countries to ensure global relevance

Exclusion Criteria

The following types of studies were excluded:

- Studies not reporting relevant data on radiation safety or compliance
- Abstracts, conference proceedings, letters to the editor, and unpublished theses
- Non-English language publications

Data Extraction and Synthesis

After screening for relevance and eligibility, full texts of selected articles were reviewed in detail. A standardized data extraction form was used to collect the following information:

- Author(s), year, and country of study
- Study design and sample size
- Participant demographics (e.g., dental assistants, students, interns)
- Key findings related to knowledge, practices, and compliance with radiation safety protocols
- Identified barriers and enablers
- Recommendations for improving safety compliance

A qualitative synthesis was then performed to identify common themes, variations across regions, and recurring challenges or recommendations. Quantitative results (e.g., percentage of compliance or knowledge scores) were summarized in narrative form to compare across studies.

No meta-analysis was conducted due to heterogeneity in study designs, populations, and outcome measures.

Quality Assessment

The quality of included studies was assessed using adapted checklists based on:

- STROBE guidelines (Strengthening the Reporting of Observational Studies in Epidemiology) for cross-sectional studies
- CASP tools (Critical Appraisal Skills Programme) for qualitative studies
- PRISMA criteria were referred to for identifying relevant systematic reviews

Studies were not excluded based on quality alone but were critically discussed to reflect strength or limitations of the evidence.

DISCUSSION

Knowledge and Awareness among Dental Assistants

Several recent studies indicate that dental assistants (and related support personnel) often have reasonably good baseline awareness of radiation hazards, but there remain significant deficiencies, especially in technical or regulatory aspects (9).

For instance, a cross-sectional study in Riyadh, Saudi Arabia among dental hygienists, dental assistants, and dental assistant interns (n = 321) found that 75.7% of participants answered knowledge/awareness questions correctly. However, there were specific gaps: continuous reinforcement of the ALARA principle and safety during pregnancy were singled out as areas needing improvement (9).

Another study ("Assessing the Adherence to Safety Protocol Among Personnel in Dental Radiology Department") involving auxiliary staff, radiographers and students reported that while general awareness was favourable, detailed adherence in practice was lower; e.g., wearing of personal protective devices was affirmed by ~71.4% for some devices, but consistent application in all situations was less universa (10).

These findings align with broader systematic reviews (e.g. Radiation protection in dentistry: a KAP systematic review) which show wide variability in knowledge. Certain studies report knowledge scores "adequate" (roughly 55-80% correct), but many show knowledge of specific concepts (such as dose rates, operator distance, legal/regulatory requirements, background radiation, dose limits) to be weak (11,12,13).

Thus, while many dental assistants understand that there are risks associated with X-rays, fewer are fully conversant with technical or regulatory safety protocols. This partial knowledge undermines full compliance.

Practice and Compliance Gaps

Awareness does not always translate into consistent safe practice. Several studies document this gap:

- In the Indian study "Compliance of dentists with safety standards…", only about 19.8% of dentists (includes radiology staff) demonstrated "good" radiation protection practices. Many lacked up-to-date equipment, had machines not approved or regularly inspected, and often did not use key protective barriers adequately (14).
- In the systematic review, practices such as use of lead aprons, thyroid collars, operator distance, rectangular collimation, monitoring of exposure or cumulative dose, use of digital rather than analog receptors, etc., show marked variability. In many settings, portions of these protective measures are not used or are inconsistently used (15).
- Also, in the Riyadh study (assistants and interns), while knowledge was "adequate," the study authors specifically noted that protocols during pregnancy and frequent reinforcement of safety principles (including ALARA) were not consistently followed (16).

Barriers identified include:

- Lack of continuing education or refresher training to update on newer safety standards.
- Insufficient regulatory oversight or weak enforcement of existing regulations in some clinics.
- Variability in resources: older X-ray machines, lack of digital receptors, absence or poor quality of protective equipment (lead aprons, thyroid shields, barriers).
- Time pressures or workflow constraints that lead to cutting corners (e.g. skipping protective measures when patient throughput is high).
- Perhaps lack of clear responsibility: sometimes assistants may not feel fully responsible or empowered to enforce safety protocols.

Role of Dental Assistants in Ensuring Radiation Safety

Dental assistants have a potentially pivotal role:

1- Implementation of Safety Measures

Assistants often prepare the patient, set up the equipment (if under supervision or if certified), position protective barriers (aprons, thyroid collars), help with positioning to minimize retakes, manage film/sensor placement. Good practice by assistants can reduce unnecessary exposure.

2- Monitoring and Quality Assurance

Assistants may help in tracking equipment maintenance, verifying that shielding is intact, ensuring signage, and that operator/operator-distance rules are obeyed. In clinics with formal radiation safety officers (or supervisor roles), assistants may assist in audits, checks, or logging exposure records.

3- Patient Education and Consent

Assistants often inform patients about what to expect during radiographs, including safety features (e.g. lead apron) and sometimes deal with patient concerns about radiation. Their ability to explain and reassure contributes to compliance (e.g. patients cooperating to avoid retakes).

4- Regulatory Compliance

Depending on jurisdiction, assistants may be required to have certifications, adhere to legal requirements, document exposures, ensure equipment is approved/inspected. Their compliance helps the clinic comply legally.

However, evidence suggests that in many places assistants either are not fully trained to carry out these roles, or their roles are not clearly defined regarding safety responsibilities.

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Enablers and Best Practices

From literature, the following factors are associated with better compliance and safer practice:

- Standardized and recurring training: Courses during initial education and regular refresher workshops increase knowledge and practice. Studies show continuous training is associated with better knowledge and better safety practices.
- Availability and quality of protective equipment: Clinics that have good equipment (lead barriers, up-to-date machines, digital receptors) facilitate compliance. Where resources are lacking, even willing assistants cannot always fully comply.
- Institutional policies and oversight: Formal protocols, safety manuals, audits, and a culture that emphasizes radiation protection help. Supervisors or dentists who enforce rules make a difference.
- Regulatory frameworks: Jurisdictions with strong enforcement and regular inspections see higher compliance. When equipment licensing is enforced, and when there are legal repercussions, clinics are more likely to maintain safety standards.
- Monitoring and feedback: Use of personal dosimeters, logs of retakes, tracking exposures, and feedback to staff can reinforce good practices.

Implications and Challenges

Given the gaps, there are several implications:

- For patient safety: Poor practice increases unnecessary radiation exposure, increasing stochastic risks (even if individual radiographs are low dose).
- For staff safety: Assistants repeatedly exposed may accumulate exposure, especially if protective equipment is not consistently used.
- For legal/ethical risk: Clinics not complying with safety regulations may be subject to sanctions, liabilities, or loss of accreditation.

Challenges include:

- Variability in regulations and standards across regions: what is required in one country or state may not be in another.
- Costs: procurement of quality protective gear, digital imaging equipment, maintenance.
- Ensuring training reaches all assistants, including those in smaller practices or private clinics.
- Overcoming behavior inertia: even when knowledge exists, practice often lags

Recommendations Based on Literature

From the evidence, to improve compliance and the role of dental assistants, the following are recommended:

- Mandate radiation safety certification for dental assistants, including hands-on components.
- Require continuing education (e.g., every 2-3 years) covering current guidelines, pregnancy safety, ALARA principle, new imaging technologies.
- Establish clear clinic protocols that define assistant responsibilities, including enforcing use of protective equipment, monitoring exposure, and auditing practice.
- .Ensure all clinics have adequate, properly maintained safety equipment (lead aprons, thyroid collars, barriers, dosimeters).
- Incorporate safety culture: provide feedback, encourage reporting of safety lapses, integrate safety discussions into regular team meetings.
- Regulatory bodies should conduct inspections, enforce licensing of equipment, ensure that X-ray machines are certified/approved, and ensure radiation safety regulations are up to date.

CONCLUSION

Dental assistants are integral to the safe operation of radiographic procedures in dental clinics. While most DAs possess a basic understanding of radiation safety, compliance with protocols remains inconsistent due to variable training, limited institutional oversight, and knowledge gaps. Enhancing their role requires a multifaceted approach—standardized education, institutional support, and a robust culture of safety. By empowering dental assistants with knowledge, tools, and accountability, dental clinics can ensure better protection for both staff and patients, aligning with global standards of radiation safety.

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