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RESEARCH ARTICLE

RADIATION AWARENESS AMONG DENTAL PRACTITIONERS IN WESTERN MAHARASHTRA: A CROSS-SECTIONAL STUDYSourav Lolage¹, Asmita Ramesh Hamand²¹Dental surgeon, School of Dental Sciences, Krishna Vishwa Vidhyapeeth, Karad, Maharashtra, India Email ID: abhijethure@gmail.com²Assistant Professor, Department of Public Health Dentistry, Krishna Vishwa Vidhyapeeth, Karad, Maharashtra, India,**Corresponding author***: Dr. Asmita Ramesh Hamand, Assistant Professor, Department of Public Health Dentistry, Krishna Vishwa Vidhyapeeth, Karad, Maharashtra, India, Karad 415539 Maharashtra, IndiaE-mail: asmihamand@gmail.com**Received:** Apr 15, 2025; **Accepted:** May. 15, 2025; **Published:** May. 31, 2025**ABSTRACT**

Objective: This study aimed to evaluate the awareness and implementation of radiation protection measures among dental practitioners in Western Maharashtra, with a focus on knowledge, attitudes, and clinical practices related to radiographic safety.

Materials and Methods: A descriptive cross-sectional survey was conducted among 200 dental practitioners using a structured questionnaire comprising 10 key questions. Descriptive statistical analysis was done by using SPSS (version 23).

Results: The majority of participants demonstrated awareness of radiation safety, with 100% performing clinical evaluations before radiographic prescriptions and 87% obtaining informed consent. However, only 74% explained radiation risks to patients, and just 28% used film-holding devices, highlighting gaps in protective practices. 73% of participants stated using TLD badges. Notably, 98% stood behind a protective shield during exposure.

Conclusion: Although the findings indicate a generally positive trend in radiation awareness among dental practitioners, inconsistencies persist in the implementation of optimal safety practices, particularly in areas such as informed consent, use of film holders, and radiation dose monitoring. These gaps underscore the need for enhanced continuing dental education, stricter adherence to safety protocols, and reinforcement of regulatory guidelines to ensure the safe use of radiography in clinical settings.

Keywords: Dental radiography, radiation safety, ALARA principle, informed consent, lead apron, TLD badge, Western Maharashtra, dental practitioners, radiation protection practices.

INTRODUCTION

Radiographic imaging has become an indispensable tool in modern dentistry, facilitating accurate diagnosis and effective treatment planning. Dental X-rays enable clinicians to detect conditions not visible during routine examinations, such as interproximal

caries, periapical lesions, and bone pathologies, thereby enhancing patient care¹.

Despite the diagnostic benefits, dental radiography involves exposure to ionizing radiation, which, albeit low in individual doses, can accumulate over time and pose

health risks to both patients and practitioners². Potential risks include cellular damage and an increased likelihood of malignancies, particularly with repeated exposures³. Therefore, it is imperative to balance the diagnostic advantages of radiographs with the principles of radiation protection.

A fundamental concept in radiation safety is the ALARA principle-"As Low As Reasonably Achievable." This principle advocates for minimizing radiation exposure by employing the lowest possible dose to achieve the necessary diagnostic outcome⁴. Implementing ALARA involves using appropriate shielding, selecting suitable imaging techniques, and limiting the frequency of radiographic examinations.

Best practices in dental radiography encompass several strategies aimed at reducing radiation exposure. These include the use of digital radiography, which significantly lowers radiation doses compared to traditional film-based methods⁵. Additionally, employing rectangular collimation restricts the X-ray beam to the area of interest, thereby minimizing exposure to surrounding tissues⁶. Regular maintenance and calibration of radiographic equipment are also crucial to ensure optimal performance and safety⁷.

Educational training plays an essential role in encouraging radiation safety. Dental professionals must be well-versed in radiographic techniques, radiation biology, and protection measures. Continuous professional development programs and adherence to updated guidelines are essential to maintain high standards of practice⁸.

Effective communication with patients regarding the necessity and safety of radiographic procedures is equally important. Providing clear explanations about the benefits and potential risks fosters trust and facilitates informed decision-making. Obtaining informed consent before radiographic examinations is not only an ethical obligation but also a legal requirement in many jurisdictions⁹.

Regulatory bodies, Atomic Energy Regulatory Board (AERB) in India, form guidelines to safeguard the use of ionizing radiation in medical and dental practices. Compliance with these regulations is mandatory and underscores the ethical responsibility of dental practitioners to safeguard patient and staff well-being¹⁰. Despite the availability of guidelines and training resources, studies have indicated variability in the awareness and implementation of radiation safety measures among dental professionals¹¹.

Factors contributing to this inconsistency include a lack of access to continuing education, inadequate emphasis on radiation protection in dental curricula, and limited enforcement of regulatory standards.

In the context of Western Maharashtra, there is a paucity of data assessing the knowledge, attitudes, and practices related to radiation safety among dental practitioners. The purpose of this study was to fill this gap by evaluating the current state of radiation awareness and protective practices in the region. The findings are expected to inform targeted interventions to enhance radiation safety in dental settings.

MATERIAL AND METHOD

Study Design

A descriptive cross-sectional study was conducted over six months, targeting dental practitioners across Western Maharashtra. A total of 200 practitioners participated, selected through convenience sampling.

Data Collection Tool

A structured questionnaire comprising 10 predetermined questions was employed. The questionnaire assessed:

- Clinical evaluation before prescribing radiographs
- Patient inquiries about radiation safety
- Explanation of radiation risks/benefits to patients
- Obtaining informed consent
- Methods of holding image receptors
- Awareness of collimators
- Use of protective gear (lead aprons, thyroid collars)
- Practitioner positioning during exposure
- Maintenance and periodic checks of radiographic equipment

Data Analysis

Responses were analyzed using SPSS version 23. Descriptive statistics were computed.

Ethical Considerations

The Ethical clearance was obtained from the Ethical Committee of Krishna Vishwa Vidyapeeth (KVV), Karad, with Protocol number (123/2024-2025, dated 28/08/2024).

Informed consent was obtained from all participants. Confidentiality was maintained throughout the study.

Table 1. Summary of Survey Responses

| Question | Yes (%) | No (%) |
|--|---------|--------|
| Clinical examination and history before the radiograph | 100 | 0 |
| Informed consent obtained | 87 | 13 |
| Patients ask about radiation safety | 69 | 31 |
| Explain the radiation risk/benefit | 74 | 26 |
| Sensor held by the patient | 25 | — |
| Sensor held by the operator | 47 | — |
| Sensor held using the film-holding device | 28 | — |
| Cone length used: 8 inches | 67 | — |
| Cone length used: 16 inches | 33 | — |
| Stand behind the lead shield | 98 | 2 |
| Use of lead apron and thyroid collar | 89 | 11 |
| Stand away during radiographic exposure | 90 | 10 |
| Use of TLD badge | 73 | 27 |

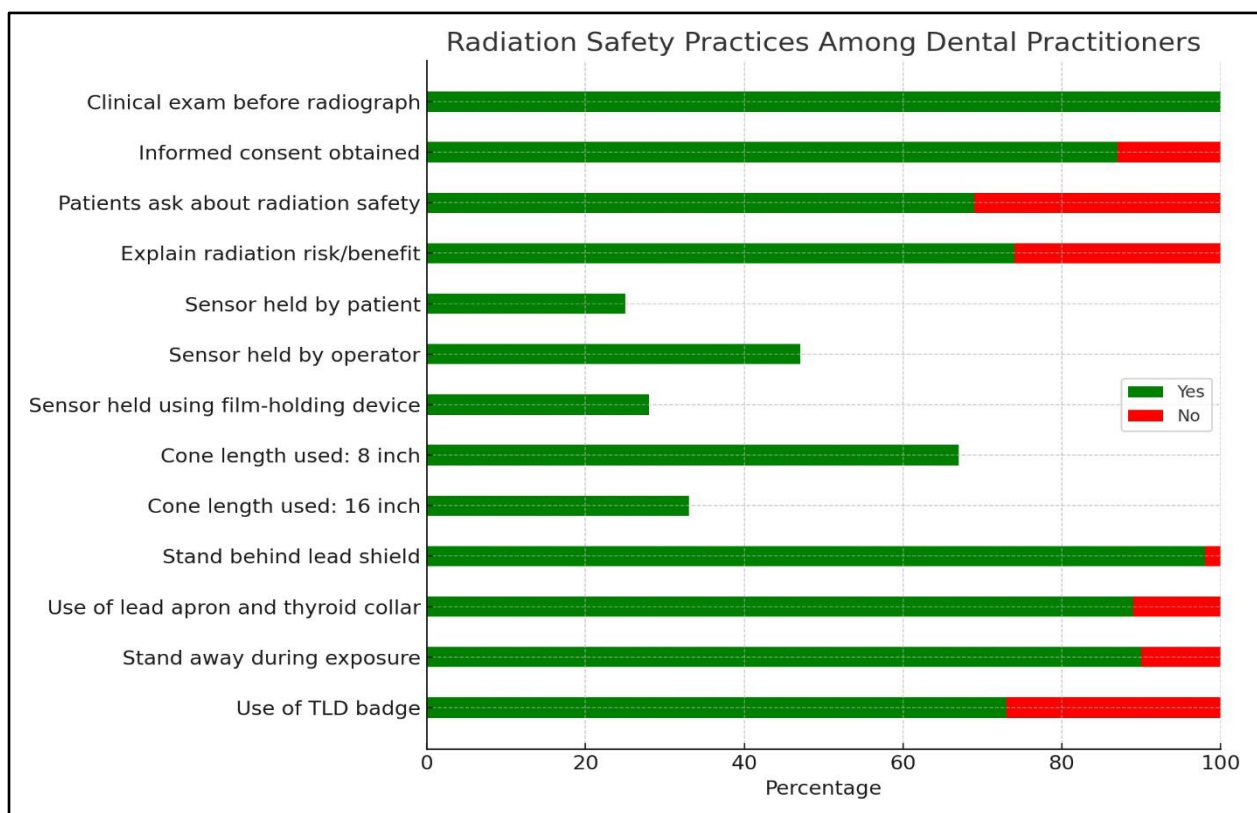


Figure 1. Radiation safety practice among dental practitioners

Key Findings:

- **Clinical Evaluation:** 85% reported conducting a thorough clinical examination before prescribing radiographs.
- **Patient Communication:** Only 40% routinely explained radiation risks and benefits to patients.
- **Informed Consent:** 35% obtained informed consent before radiographic procedures.
- **Protective Measures:** While 68% used lead aprons, only 43% employed thyroid collars consistently.
- **Practitioner Safety:** 59% stood behind a protective barrier during exposure; 23% maintained a 6-foot distance without a barrier.
- **Equipment Maintenance:** 47% conducted periodic checks of their radiographic equipment.

DISCUSSION

The study reveals a moderate level of awareness regarding radiation safety among dental practitioners in Western Maharashtra. While most practitioners recognize the importance of clinical evaluation before radiography, there is a noticeable gap in patient communication and informed consent practices.

A significant positive finding in this study is that 100% of the respondents reported considering clinical examination before radiographic exposure. This adherence to the principle of clinical justification is crucial, as it ensures that radiographs are only taken when medically necessary. The adherence to the ALARA (As Low As Reasonably Achievable) principle is encouraging, as it helps minimize unnecessary radiation exposure to both patients and operators¹². However, amenability with ALARA includes more than just evaluating the necessity of radiographs. Optimizing radiation doses requires the proper selection of exposure settings and the application of effective shielding methods. Studies have shown that while clinical justification is important, it must be accompanied by technical measures like adjusting exposure parameters (e.g., exposure time, tube potential, and current) and using appropriate shielding techniques to achieve dose optimization¹³. Without these considerations, the mere evaluation of necessity may not fully reduce radiation exposure.

The findings reveal that 87% of the respondents reported taking informed consent from patients, and 74% explained the potential risks associated with radiation. These practices align with legal and ethical standards in patient care¹⁴. Transparent communication is essential for fostering trust between the dentist and the patient, which in turn improves the overall patient experience. Furthermore, according to the American Dental Association, informed consent not only serves as a legal safeguard but also empowers patients to make well-informed decisions regarding their treatment options¹⁵. Despite this, the fact that a portion of practitioners still fail to adequately explain radiation risks highlights a gap in ethical communication. This deficiency could lead to patients feeling uninformed or uncertain about the procedures, which may lead to legal implications and undermine the patient's autonomy. Thus, enhancing communication and ensuring that all patients receive clear, detailed explanations of the risks and benefits of radiographic procedures is crucial.

The study found that 89% of dental practitioners used lead aprons and thyroid collars during radiographic

procedures, which aligns well with international guidelines on radiation protection¹⁶. These protective measures are effective in reducing unnecessary radiation exposure, particularly in sensitive areas like the thyroid and reproductive organs. However, only 28% of respondents used film-holding devices, which play a critical role in reducing radiation exposure to the operator. Operator-held radiographs, reported at 47%, are contrary to recommended safety practices. Holding films manually increases the risk of occupational radiation exposure to dental staff¹⁷.

The study revealed that most practitioners used an 8-inch cone, which is associated with higher levels of scatter radiation compared to a 16-inch cone. Research has shown that the use of a longer cone (16 inches) helps to reduce the amount of scatter radiation, thereby decreasing the overall radiation dose to the patient and improving image quality¹⁸. The 16-inch cone allows for a more parallel beam of radiation, which leads to better collimation, further optimizing the radiographic procedure by reducing the area exposed to radiation. Although shorter cones are easier to handle, they should be replaced by longer cones where feasible to adhere to best practices in radiographic safety.

The study also highlighted that 98% of dental practitioners adhered to standing behind lead shields during radiographic exposure, and 90% maintained an appropriate distance from the radiation source. These measures align with established protocols for protecting dental staff from unnecessary radiation exposure¹⁹. However, the use of thermoluminescent dosimeter (TLD) badges for personal radiation monitoring was reported by only 73% of participants. TLD badges are essential tools for monitoring and recording the cumulative radiation dose received by personnel, which is vital for ensuring that occupational exposure stays within a safe limit²⁰. The underuse of TLD badges suggests that more awareness and training are needed to emphasize their importance in protecting the health of dental professionals.

Variability in radiation safety practices, including inconsistent use of collimators, sensor handling, and informed consent procedures, underscores the need for structured continuing dental education (CDE) programs. While the majority of practitioners seem aware of the basic radiation safety principles, there is still a significant gap in the consistent application of these practices. Research has indicated that regular participation in CDE programs is associated with improved knowledge and adherence to radiographic safety protocols²¹. Continuing education programs can provide updates on the latest guidelines, reinforce the

importance of radiation safety, and address areas where dental practitioners may be lacking in their practice.

CONCLUSION

In conclusion, while the study reveals positive trends in radiation safety practices among dental practitioners in Western Maharashtra, several areas require attention to further enhance safety for both patients and dental professionals. Improvements are needed in areas such as the consistent use of film-holding devices, informed consent procedures, and radiation dose monitoring for personnel. By addressing these gaps through better training, stricter adherence to guidelines, and the use of modern protective equipment, dental practitioners can ensure safer radiographic practices, which will benefit both the patients they treat and the staff who operate the equipment. While these findings are meaningful, they should be interpreted in light of the study's limitations, including its reliance on self-reported data, limited geographic scope, lack of observational validation, and exclusion of patient perspectives.

Future studies with broader regional coverage, objective assessments of clinical practices, and longitudinal follow-up are recommended. Additionally, greater emphasis on structured continuing education and hands-on training programs can help bridge the gap between knowledge and consistent, safe practice. By addressing these limitations, future research can contribute more comprehensively to the advancement of radiation safety in dental practice.

DECLARATIONS

Ethical statement

This study was performed in line with the principles of the Declaration of Helsinki.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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