



Original Research

Assessing the Use of Radiation Protection Equipment: A Cross-Sectional Survey Among Dental Students

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ABSTRACT

Background: Proper radiation protection is crucial for minimizing exposure risks in dental radiography. This study aimed to evaluate the knowledge, awareness, and practices of dental students regarding radiation protection equipment.

Methods: A cross-sectional, questionnaire-based study was conducted with 100 dental students, including third-year students, final-year students, interns, and postgraduates. The questionnaire assessed participants' understanding of radiation protection principles, use of protective equipment, and attitudes toward radiation safety. Data were analyzed using statistical methods, including chi-square tests.

Results: The study found that 73% of participants had good knowledge and awareness of radiation protection equipment and radiation dosage. Despite this, adherence to recommended practices was poor. A significant association was observed between gender and the use of lead aprons during radiographs (p -value = 0.03), indicating a difference in practice based on gender.

Conclusion: While dental students generally exhibit strong knowledge and awareness of radiation protection, there is a notable gap in the practical application of protective measures. The findings highlight the need for improved training and adherence to radiation safety practices to ensure the well-being of both patients and practitioners.

Keywords: Radiation Protection, Lead Aprons, Thyroid Collars, ALARA Principle, Radiation Safety

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INTRODUCTION

Dental radiographs are essential tools for diagnosing oral conditions and guiding appropriate treatment plans. Their frequent use in dental offices underscores their importance. Although radiation doses from dental x-rays are low and generally considered to pose minimal risk, radiographs serve multiple purposes, such as detecting hidden structures, assessing bone density, and identifying masses or cavities. X-rays, a form of electromagnetic radiation with short wavelengths and high frequencies, can ionize atoms by producing charged particles, which may damage biological tissues. The effects of radiation on living organisms vary based on the dose and exposure duration, which is why balancing the risks and ensuring the safety of both patients and healthcare professionals is critical.¹

Dental students are at a high risk of exposure to ionizing radiation during their clinical training and practice. The implementation and proper use of radiation protection equipment are crucial for minimizing this risk; however, the level of awareness and adherence to protective measures among dental students remains a topic of concern in the literature.² Despite foundational education on safety protocols provided during their training, many students may lack practical knowledge regarding the specific types of radiation protection equipment available and their correct application in clinical settings, necessitating further exploration into educational gaps and the development of targeted intervention strategies.³ Moreover, existing studies indicate that there is a pressing need to enhance the curriculum related to radiation safety, as many dental students express uncertainty about the best practices for minimizing radiation exposure during patient procedures, reflecting a broader trend of insufficient training in critical safety measures within the field (Awawdeh et al., 2023) (Bajalan et al., 2022) (Doshi et al., 2017).⁴

Given their frequent exposure to ionizing radiation during clinical training, dental students must have a strong grasp of radiation protection. This knowledge is essential for minimizing exposure risks to both themselves and their patients, helping to prevent radiation-related health issues. Proper training in radiation safety not only ensures adherence to regulations but also promotes a safer clinical environment and strengthens patient confidence in dental care.⁵

While the risks from diagnostic x-rays are small, proper precautions are necessary. Lead aprons are commonly used as protective garments in dental settings, particularly during fluoroscopy. Special attention should be given to protecting the thyroid gland, as it is particularly vulnerable to scattered radiation. Thyroid shields significantly reduce the risk of radiation-induced thyroid cancer. Lead, due to its high density and atomic number, is effective at blocking gamma rays and x-rays, which is why it is widely used in protective gear such as aprons, glasses, and gloves.⁶ These garments and accessories must be well-maintained and regularly inspected for damage to ensure continued effectiveness.

The principle of ALARA (As Low As Reasonably Achievable) is central to radiation protection, aiming to minimize exposure while ensuring effective use. For dental students, understanding radiation protection is crucial to safeguard both themselves and their patients.⁷ The amount of radiation exposure during dental radiography depends on several factors, including film speed, exposure settings, and the use of collimation and protective barriers. Although dental x-rays are associated with low radiation doses and relatively low risk, awareness of radiation protection measures is essential. However, dental students may face limitations in fully applying radiation protection principles, including inconsistent access to protective equipment or inadequate practical training.^{8,9} Furthermore, the theoretical knowledge gained during coursework may not always translate effectively into clinical practice due to a lack of hands-on experience or mentorship in real-world settings. These gaps highlight the need for continuous education and reinforcement of safety protocols.

This study aims to assess the knowledge, awareness, and practices regarding radiation protection equipment among dental students.

MATERIALS & METHODS:

This cross-sectional, questionnaire-based study was conducted to assess the use of radiation protection equipment among 100 dental students whose curriculum included Dental Radiology. The study sample included third-year students, final-year students, interns, and postgraduates who met the inclusion criteria. A questionnaire was developed to evaluate the knowledge, awareness, and practices of dental students and interns regarding radiation safety and protection. The first section of the questionnaire aimed to categorize participants as undergraduate students or interns and to record their gender. The second section assessed their knowledge, awareness, and practices related to radiation hazards and protection methods and guidelines.

The study was done using a structured questionnaire to a sample of dental students from various academic levels at a dental college/university. The survey took place over a three-month period, from June 2023 to September 2023. The target population included dental students currently enrolled in clinical training programs. Ethical approval for the study was obtained from the Institutional Review Board (IRB) of [Insert Institution]. Informed consent was obtained from all participants, and anonymity was assured. Participation was voluntary, and students could withdraw at any time without any consequences. This method ensured comprehensive data collection on the knowledge, awareness, and practices related to radiation protection among dental students.

Inclusion Criteria:⁹

1. Participants must be currently enrolled as dental students or be practicing dental professionals, including interns and postgraduates, in institutions where Dental Radiology is part of the curriculum.
2. Participants from third year, final year, interns, and postgraduates are included to capture a range of experience levels.
3. Participants must provide informed consent to participate in the study and complete the questionnaire on radiation protection knowledge and practices.

Exclusion Criteria:

1. Individuals not enrolled in dental programs or not currently practicing as dental professionals are excluded.
2. Participants who do not fully complete the questionnaire or provide incomplete or inconsistent responses are excluded from the analysis.
3. Individuals who have received specialized training or certification in radiation safety beyond standard dental education are excluded to avoid skewing the results due to advanced knowledge.
4. Participants who are unable to understand or respond to the questionnaire due to language barriers are excluded to ensure accurate responses.

The study included a total of 100 participants. The sample comprised dental students from third year, final year, interns, and postgraduates who met the inclusion criteria and were enrolled in institutions where Dental Radiology was part of the curriculum. This sample size was chosen to ensure a diverse representation of experience levels and to provide sufficient data for analyzing knowledge and practices related to radiation protection.

Data were collected through a self-administered questionnaire distributed either online or as printed copies. The questionnaire consisted of three sections: A structured questionnaire was developed to assess participants' knowledge, awareness, and practices related to radiation protection and safety. The questionnaire was divided into sections to evaluate: Demographic information (year of study, gender),

knowledge and awareness of radiation protection principles and equipment, practices regarding the use of protective measures such as lead aprons, thyroid collars, and collimators. The questionnaire was reviewed by two experts in radiation safety and dentistry for validity, and a pilot study was conducted with 10 students to ensure clarity and reliability. Minor adjustments were made based on feedback.

STATISTICAL ANALYSIS:

Survey responses were analyzed using IBM SPSS Statistics 25. Descriptive statistics were used to summarize demographic data and responses. Chi-square tests were employed to determine associations between demographic factors and knowledge/practice of radiation protection. A p-value of <0.05 was considered statistically significant.

RESULTS:

The study evaluated the knowledge, attitudes, and practices concerning radiation protection equipment among dental practitioners. A total of 100 participants took part in the survey, with 60% being female and 40% male. The participants were categorized as follows: 37% were in their third year, 17% in their fourth year, 27% were interns, and 19% were postgraduates. Participants' responses to various questions assessing their awareness of radiation protective equipment are illustrated in Figures 1 through 10.

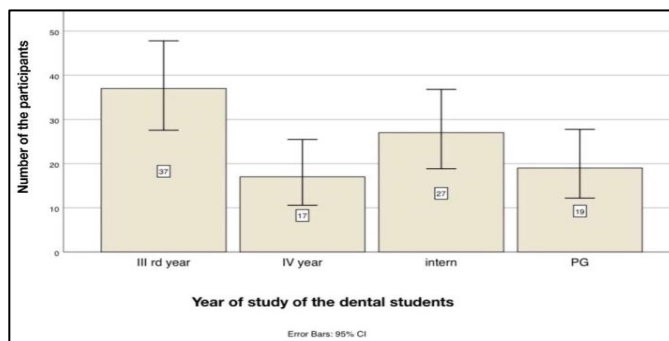


Fig 1: The bar chart illustrates the distribution of dental students by their year of study. The X-axis denotes the year of study, while the Y-axis shows the number of participants. The chart reveals that 37% are in their third year, 17% are in their fourth year, 27% are interns, and 19% are postgraduates.

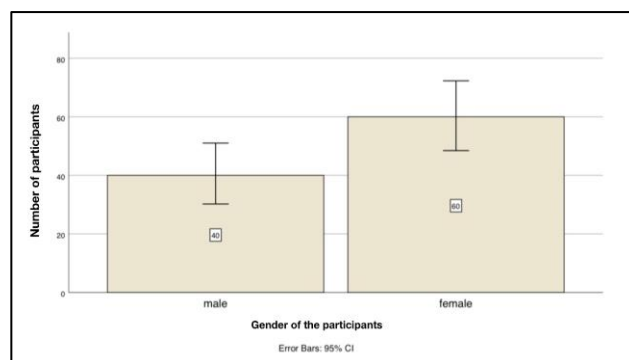


Fig 2: The bar chart displays the gender distribution of the participants. The X-axis represents gender, while the Y-axis indicates the number of participants. The chart shows that 60% of the participants were female, and 40% were male.

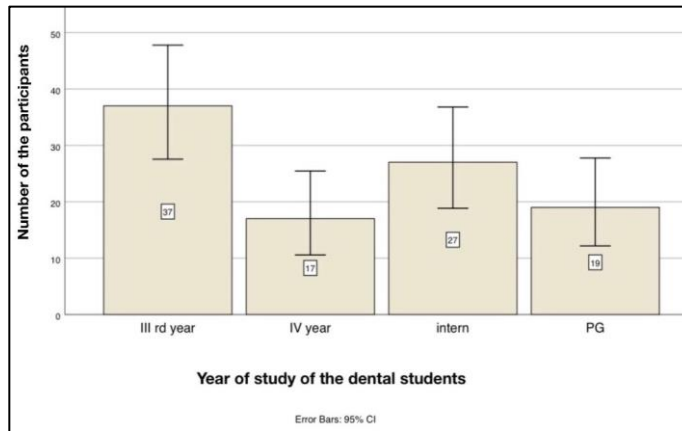


Fig 3: The bar graph illustrates dental practitioners' responses regarding the use of lead aprons during radiographs. The X-axis represents the different responses, while the Y-axis shows the number of respondents. The responses are as follows: 35% indicated "always," 20% said "very often," 25% reported "sometimes," and 20% responded "no."



Fig 4: The bar graph depicts dental practitioners' responses regarding the use of lead goggles during radiographs. The X-axis represents the different responses, while the Y-axis shows the number of respondents. The distribution of responses is as follows: 30% said "always," 21% said "mostly," 29% said "sometimes," and 20% said "never."

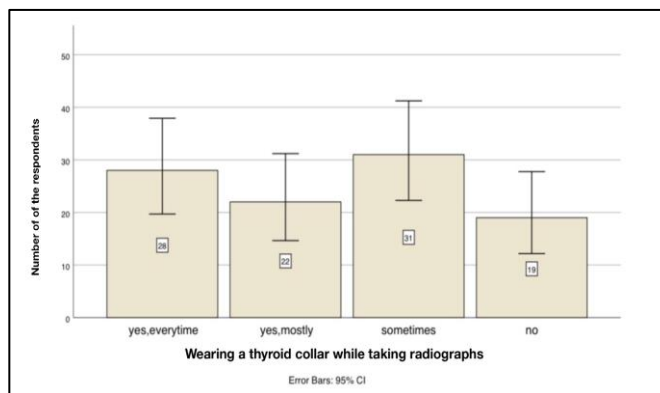


Fig 5: The bar chart shows dental practitioners' responses regarding the use of thyroid shields during radiographs. The X-axis represents the different responses, while the Y-axis indicates the number of respondents. The responses are as follows: 28% said "yes, every time," 22% said "yes, mostly," 31% said "sometimes," and 19% said "no."

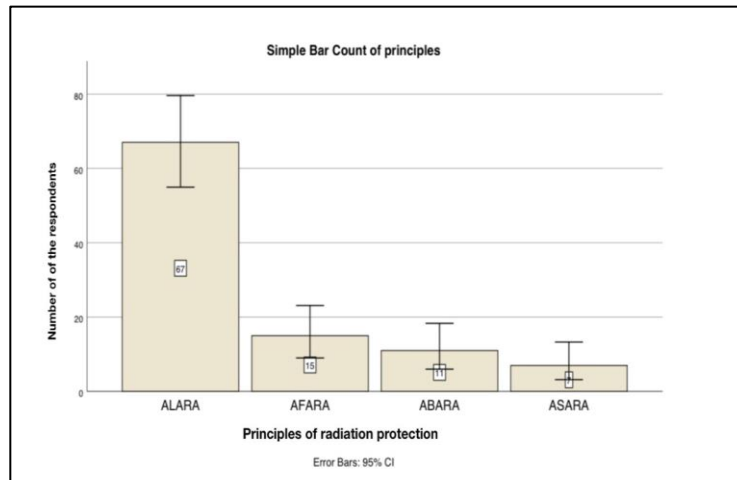


Fig 6: The column chart illustrates dental practitioners' responses regarding the "principle of radiation protection." The X-axis shows the different responses, while the Y-axis represents the number of respondents. The responses are as follows: 67% chose "ALARA," 15% chose "AFARA," 11% chose "ABARA," and 7% chose "ASARA."

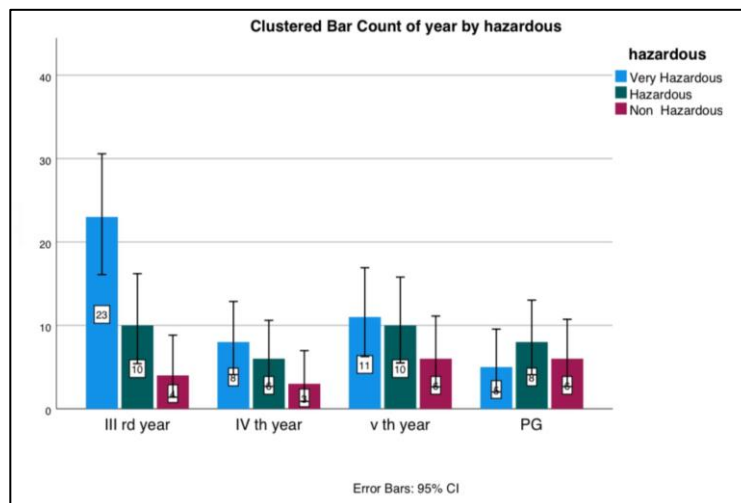


Fig 7: The bar graph depicts the relationship between the year of study and dental practitioners' perceptions of the harmful effects of X-rays. The X-axis represents the participants' year of study, while the Y-axis shows their responses regarding X-ray hazards. The colors indicate responses as follows: blue for "very hazardous," green for "hazardous," and maroon for "non-hazardous." A chi-square test was conducted, resulting in a p-value of 0.06 ($p < 0.05$), indicating an insignificant difference between responses and the year of study. Third-year students perceive X-rays as more hazardous compared to students in other years.

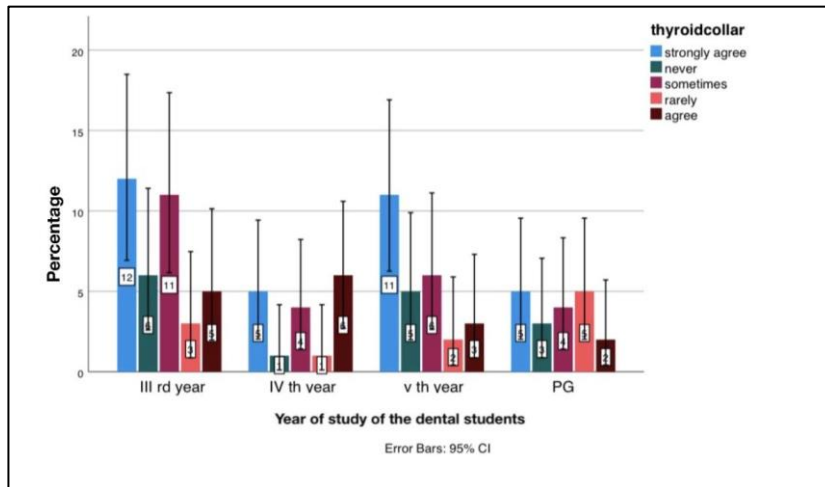


Fig 8: The bar chart illustrates the association between dental practitioners' responses regarding the use of thyroid collars during radiographs and their year of study. The X-axis shows the year of study, while the Y-axis represents the practitioners' responses. The colors indicate responses as follows: blue for "strongly agree," green for "never," grey for "sometimes," purple for "rarely," and yellow for "agree."

DISCUSSION

The data presented in the figures provide insights into dental practitioners' knowledge and practices regarding radiation protection. The results from this study provide a snapshot of the current state of awareness and practices related to radiation protection among dental practitioners. The data indicate that while there is a general awareness of key principles like ALARA (As Low As Reasonably Achievable), there are significant gaps in the consistent use of protective measures and knowledge about radiation safety guidelines.¹⁰ The majority of practitioners are familiar with the ALARA principle, which is critical for minimizing radiation exposure. However, there is a discrepancy in understanding and applying this principle among different studies. This variation highlights the need for standardized education across dental programs to ensure all practitioners have a thorough understanding of radiation safety principles.¹¹

In the figure 3 the variability in the use of lead aprons among dental practitioners when taking radiographs. Specifically, 21% of practitioners reported always wearing lead aprons, 21% wore them very often, 25% wore them sometimes, and 18% never wore them. These findings align with the study by Rholin, which identified poor awareness about radiation protection equipment as a possible factor influencing these practices. Increasing awareness and education about the importance of radiation protection equipment are crucial for ensuring that dental practitioners consistently use such protective measures to mitigate the harmful effects of X-rays. A notable portion of practitioners inconsistently use lead aprons and thyroid collars during radiographic procedures. Despite a significant percentage acknowledging the importance of these protective measures, adherence varies, with some practitioners not using them regularly. This inconsistency suggests a need for enhanced training and reinforcement of the importance of using protective equipment consistently.¹²

The study found that a significant percentage of participants were not aware of ICRP recommendations or the use of collimators. This lack of awareness is consistent with findings from other studies, suggesting that gaps in knowledge about specific radiation protection measures persist. Improving educational efforts to cover these aspects comprehensively could enhance overall safety practices. Figure 6 shows that 67% of the dental practitioners identified the ALARA (As Low As Reasonably Achievable) principle as the key

radiation protection principle, while 15% chose AFARA, 11% selected ABARA, and 7% chose ASARA. This finding is consistent with a general understanding of ALARA, which is vital for limiting radiation exposure. However, a study by Joan at the University of Benin contradicted these findings, indicating that dental students had a poor grasp of the ALARA principle. This discrepancy suggests that while many are familiar with ALARA, there remains a gap in the thorough understanding and application of this principle. Improving education on ALARA is essential to ensure dental students and practitioners can effectively manage radiation exposure.¹³

The perception of X-ray hazards and the use of protective measures varied with the year of study, with third-year students often exhibiting higher awareness and concern.^{14,15} This variation implies that awareness may increase with education and experience, but also indicates that ongoing education throughout the dental program is necessary to maintain and deepen understanding of radiation protection.¹⁶ Figure 7 illustrates the association between year of study and perceptions of X-ray hazards. Notably, third-year students were more likely to view X-rays as very hazardous compared to those in other years. This perception may reflect the students' ongoing education and heightened awareness of radiation risks early in their training. The chi-square test showed a p-value of 0.06, indicating that while there is a tendency for third-year students to perceive higher risks, the difference is not statistically significant.

Figure 8 examines responses to wearing thyroid collars during radiographs. Third-year students showed a stronger agreement with the use of thyroid collars, reflecting a higher awareness of their protective value. However, the chi-square test indicated that the correlation between year of study and responses was not statistically significant, with a p-value greater than 0.05. This suggests that while awareness may vary, it does not significantly correlate with the year of study. In this study, 73% of participants were not aware of ICRP recommendations on radiation protection, which aligns with Lingam's findings that about 65% of participants were similarly uninformed about NCRP/ICRP recommendations. Additionally, only 37% of students were aware of collimators' use during intraoral radiographic examinations. This finding contrasts with Rahul's study, where a majority were aware of collimators, suggesting discrepancies in awareness levels that might be due to differences in educational focus or training.

Overall, these findings underscore the need for improved educational initiatives focused on radiation protection principles and equipment. Ensuring that dental practitioners and students are well-informed about radiation safety measures, such as ALARA and the use of protective equipment like lead aprons, thyroid collars, and collimators, is essential for enhancing patient and practitioner safety.¹⁷

The study's sample size was limited to 100 dental students and practitioners, which may not fully represent the broader population of dental professionals. The study relies on self-reported data, which can be influenced by response bias. Participants might overestimate their adherence to protective practices or their knowledge of radiation safety principles, leading to potentially skewed results. The cross-sectional nature of the study captures data at a single point in time, limiting the ability to assess changes in knowledge or practices over time.¹⁸ The study primarily focused on lead aprons, thyroid collars, and collimators, which may not encompass all relevant radiation protection measures. Other important aspects of radiation safety, such as the use of shielding for equipment and environment, were not addressed, which may provide a more comprehensive view of radiation protection practices.^{19,20} Addressing these limitations in future research could provide a more comprehensive understanding of radiation protection practices and improve the development of targeted educational interventions for dental practitioners.

CONCLUSION:

In conclusion, the study demonstrated that 73% of dental students possess good knowledge and awareness regarding radiation protection equipment and radiation dosage. However, despite this awareness, there is a noticeable gap in the consistent practice of using protective measures. The significant association between gender and the use of lead aprons, as indicated by a p-value of 0.03, underscores the importance of addressing these discrepancies. In conclusion, while there is a foundational awareness of radiation protection principles among dental practitioners, there is a clear need for improved education and consistent application of protective measures. Addressing these gaps through targeted training and awareness programs will be crucial for enhancing radiation safety practices and ensuring the well-being of both patients and practitioners. Overall, while knowledge and awareness are strong, there is a critical need for improved adherence to radiation protection practices.

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CONFLICTS OF INTEREST

There are no conflicts of interest

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