



Assessment of Knowledge, Attitude, and Practice Regarding Radiation Safety Measures and Radiological Waste Management among Dental Assistants Assisting Private Dental Practitioners

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Abstract: Background: Oral and maxillofacial imaging is indispensable in routine dental practice, but radiation exposure and improper disposal of radiographic waste remain important occupational and environmental concerns. In many private clinics in India, dental assistants help operate radiographic procedures and handle related waste without formal training or structured monitoring. This study therefore evaluated the knowledge, attitude, and practice of dental assistants employed in private dental clinics in Wardha district regarding radiation safety protocols and radiological waste management. **Method:** This cross-sectional questionnaire-based study used a pre-tested, validated 26-item instrument. The first section recorded demographic information, and the second section assessed knowledge, attitude, and practice related to radiation safety measures and radiological waste management. Scores were categorized as good when the participant scored at or above the mean and poor when the score was below the mean. **Results:** Of 126 eligible dental assistants, 108 completed the study, yielding a response rate of 85.7%. Poor knowledge was observed in 49 participants (45.4%), poor attitude in 57 (52.8%), and poor practice in 77 (71.3%). Females showed significantly higher mean knowledge and attitude scores than males, whereas most subgroup comparisons by age, education, and work experience were not statistically significant. Positive correlations were observed between knowledge, attitude, and practice scores. **Conclusion:** The dominant gap identified in this survey was poor practice, despite only moderate deficits in knowledge and attitude. Private dental clinics should therefore combine structured assistant training with mandatory clinic-level support for radiation protection, radiological waste segregation, monitoring, and safe disposal. Local dental bodies, clinic owners, and regulators should collaborate to implement competency-based certificate courses and periodic refresher programs.

Key Words: Radiation Hazard, Radiology Waste, Radiation Safety, Occupational Hazard, Dental Assistants, ALARA, AERB, Lead Foil Disposal

INTRODUCTION

Oral radiology is an essential component of dental diagnosis, yet the biological effects of ionizing radiation are well documented [1,2]. The ALARA principle requires exposures to be kept as low as reasonably achievable [3], and regulatory standards exist to reduce occupational and patient risk [4,5]. In the Indian private-clinic setting, however, radiation safety is not determined only by the dentist. Dental

assistants often help position patients, expose radiographs, process films, and handle radiographic waste, meaning their knowledge and routine practice directly influence clinic safety [6-8].

Conventional film-based dental radiography also produces hazardous waste, including developer and fixer solutions, silver-containing effluent, lead foil packets, and contaminated ancillary materials [9,10]. Improper

disposal can harm both the environment and human health [11,12]. Although modern digital systems reduce some of this burden, many clinics still use conventional techniques or mixed systems. Therefore, safe radiological practice includes not only dose reduction and shielding but also proper waste segregation, storage, and disposal [13,14].

Knowledge-attitude-practice (KAP) surveys are useful for identifying training gaps, unsafe habits, and system-level weaknesses in healthcare settings [15]. Available literature has focused mainly on dentists and students [16,17], whereas dental assistants in Indian private clinics remain under-studied despite their frequent operational role in radiography and waste handling. Wardha district was selected because of its active private dental practice network and feasibility for district-level survey coverage. The present study aimed to assess knowledge, attitude, and practice related to radiation safety and radiological waste management among dental assistants in private dental clinics in Wardha district.

Study objectives

- To assess the knowledge of dental assistants regarding radiation safety measures and radiological waste management
- To assess their attitude toward radiation protection and safe radiological waste handling
- To assess their reported practice and explore associations with selected demographic variables

METHODS

Study Design and Setting

This cross-sectional questionnaire-based study was conducted over six months, from November 2019 to April 2020, among dental assistants working in private dental clinics in Wardha district.

Study Population

Dental assistants were defined as individuals assisting dentists in patient-care tasks such as patient registration, maintenance of case records, disinfection and sterilization, assistance during radiographic and operative procedures, management of biomedical wastes, and manipulation of dental materials.

Inclusion and Exclusion Criteria

Participants aged 19 years or older, with at least one year of clinic experience, and willing to provide informed consent were included. Individuals with less than one year of clinical experience and questionnaires with incomplete responses were excluded.

Data collection

All private dental clinics in Wardha district were approached. A total of 142 assistants were contacted; 126

were eligible after excluding 5 assistants with less than one year of experience and 11 who declined participation. Eighteen incomplete questionnaires were excluded from final analysis, resulting in a study sample of 108 participants. This participant pathway has been summarized in the Results section for clarity.

Data Collection Tool

Questionnaire: A closed-ended questionnaire was initially developed in English with 28 items after an extensive literature review [18,19]. Content validation was performed by seven subject experts from the dental faculty. Two non-essential questions with a content validity ratio of 0.42 were removed, yielding a final 26-item questionnaire. The final instrument was translated into Marathi by three bilingual translators and independently back-translated into English. A pilot assessment was carried out among 25 dental assistants to improve clarity and comprehensibility. Reliability was assessed by test-retest after 15 days, and internal consistency was evaluated using Cronbach's alpha. Participants completed the self-administered questionnaire after informed consent, and responses were collected the following day.

Definitions and Scoring

The questionnaire included 10 knowledge items scored as 1 for correct and 0 for incorrect responses, 9 attitude items on a five-point Likert scale, and 6 practice items scored as 1 for correct practice and 0 for incorrect practice. For this dataset, participants scoring at or above the mean for each domain were categorized as having good knowledge, attitude, or practice, whereas those scoring below the mean were categorized as poor. Radiation safety and radiological waste management were assessed together because both are integral components of safe dental radiology.

RESULTS

The study included 108 dental assistants, with the majority aged 18–30 years (50.9%) and a slightly higher proportion of females (53.7%) as shown in Table 1. The overall mean scores for knowledge, attitude, and practice were 3.91 ± 2.91 , 30.56 ± 4.40 , and 2.06 ± 0.73 respectively. Females demonstrated significantly higher knowledge and attitude scores compared to males ($p = 0.047$), whereas no significant difference was observed in practice scores; additionally, no statistically significant differences were found across age, education, or work experience groups (Table 2). When categorized, good knowledge was observed in 54.6% of participants, good attitude in 47.2%, while only 28.7% demonstrated good practice, with poor practice being significantly higher (71.3%, $p < 0.001$) as depicted in Table 3. Furthermore, a significant positive correlation was observed between knowledge and attitude ($r = 0.607$), knowledge and practice ($r = 0.567$), and attitude and practice ($r = 0.396$), indicating interdependence among these domains (Table 4).

Table 1: Demographic Characteristics of Study Participants

Variable	n (Percentage)	
Age (in years)	18-30	55 (50.9%)
	31-40	36 (33.3%)
	41-50	16 (14.8%)
	51-60	1 (0.9%)
Gender	Male	50 (46.3%)
	Female	58 (53.7%)
Religion	Hindu	81 (75%)
	Muslim	12 (11.1%)
	Christian	5 (4.6%)
	Buddhist	5 (4.6%)
	Jain	5 (4.6%)
Marital status	Unmarried	12 (11.1%)
	Married	96 (88.9%)
Education	Less than 10 th grade passed	15 (13.9%)
	10 th grade passed	38 (35.2%)
	12 th grade passed	40 (37%)
	Graduate	15 (13.9%)
Work experience in years	1-5	35 (32.4%)
	6-10	27 (25%)
	11-15	20 (18.5%)
	16-20	16 (14.8%)
	21-25	5 (4.6%)
	26-30	5 (4.6%)
Total	108 (100%)	

Table 2: Comparison of Mean Knowledge, Attitude and Practice Scores Based on Various Demographic Variables

Variable category		Knowledge scores		Attitude scores		Practice scores	
		Mean±SD	p value	Mean±SD	p value	Mean±SD	p value
Gender (Unpaired t test)	Male	3.32±2.86	0.047*	29.74±4.70	0.047*	2.08±0.60	0.844 NS
	Female	4.43±2.87		31.27±4.04		2.05±0.84	
Age in years (One way ANOVA)	18-30	3.88±3.23	0.499 NS	30.18±4.67	0.736 NS	2.07±0.79	0.631 NS
	31-40	3.67±2.48		30.91±4.73		2.05±0.64	
	41-50	4.21±2.65		30.84±2.94		2.00±0.74	
	51-60	8.00±0.00		34.00±0.00		3.00±0.00	
Education (One way ANOVA)	Less than 10 th grade passed	4.06±3.26	0.577 NS	31.53±4.01	0.072 NS	2.00±0.84	0.838 NS
	10 th grade passed	4.73±2.34		29.68±4.58		2.02±0.67	
	12 th grade passed	3.5±2.74		30.15±4.41		2.15±0.73	
	Graduate	3.95±3.13		32.93±3.63		2.00±0.84	
Work experience in years (One way ANOVA)	1-5	3.34±3.15	0.313 NS	28.88±4.95	0.069 NS	2.08±0.78	0.949 NS
	6-10	3.74±2.95		31.33±3.33		2.00±0.67	
	11-15	4.75±2.40		32.60±4.03		2.10±0.78	
	16-20	3.62±2.87		30.56±4.85		2.12±0.61	
	21-25	4.40±3.28		31.60±2.19		2.20±0.83	
	26-30	6.0±1.87		30.20±4.49		1.80±1.09	
Overall mean		3.91±2.91		30.56±4.40		2.06±0.73	

NS: Not significant, *Statistically significant

Table 3: Overall Comparison of Knowledge, Attitude, and Practice Levels Based on Scoring

Domain	Level		p value
	Good	Poor	
Knowledge	59 (54.6%)	49 (45.4%)	0.336 NS
Attitude	51 (47.2%)	57 (52.8%)	0.564 NS
Practice	31 (28.70%)	77 (71.30%)	0.000*

NS: Not significant, *Statistically significant

Table 4: Correlation between Knowledge, Attitude and Practice Scores

Parameters	Mean Knowledge	Mean attitude	Mean Practice
Mean Knowledge	1	0.607*	0.567*
Mean attitude	-	1	0.396*
Mean Practice	-	-	1

*Correlation significant at 0.01 level (2 tailed)

DISCUSSION

This study highlights an important public-health finding: the major deficiency among surveyed dental assistants was poor

practice rather than knowledge alone. This distinction is important because safe dental radiology depends not only on awareness of radiation hazards, but also on consistent real-

world adherence to shielding, distance, exposure control, and safe waste disposal [20-24]. In many private clinics, practice is likely shaped by clinic systems, availability of protective equipment, supervision, and disposal pathways as much as by individual knowledge.

Conventional oral and maxillofacial imaging generates waste such as spent developer and fixer, silver-bearing effluent, used radiographic films, lead foil packets, and other contaminated materials [25-29]. These wastes require specific handling and disposal protocols to avoid occupational and environmental harm. The findings of this study suggest that although some assistants may understand these hazards in principle, safe waste-management behavior remains inconsistent in routine practice. This has implications not only for worker safety but also for environmental protection.

Available literature on radiation safety and radiological waste management has focused predominantly on dentists, students, or general healthcare workers. Data on dental assistants in Indian private clinics remain limited. The present study therefore provides useful baseline information from Wardha district. However, the findings should be interpreted carefully because this was a self-reported survey, the sample was restricted to one district, and some subgroup analyses were limited by small cell sizes.

Females showed significantly better knowledge and attitude scores than males in the present sample. This observation should be interpreted cautiously, because the study was not designed to determine the underlying reasons for sex-based differences and several subgroup comparisons were statistically underpowered. More importantly, the study demonstrated that practice remained poor in the majority of participants regardless of subgroup, indicating that training alone may not be sufficient unless clinic systems support compliance.

The principal strength of this study is that it addresses an under-studied but operationally important workforce in private dental clinics and achieved a good response rate. Its limitations include self-reporting bias, possible social desirability bias, the district-specific setting, the use of mean-based cut-offs, and the absence of direct observation of clinic facilities or waste-disposal systems [30]. Future studies should incorporate observational audits, clinic-level variables, and pre-post evaluation of structured training programs.

Based on the present findings, competency-based certificate courses for dental assistants should specifically include ALARA principles, shielding, distance rules, exposure minimization, personal protection, radiological waste segregation, silver-containing fixer disposal, lead foil handling, and documentation of safe disposal practices. Periodic continuing dental education and clinic-level monitoring are also required so that good attitude can translate into actual practice.

CONCLUSION

The most important finding of this survey was poor practice, with 71.3% of participants showing inadequate adherence to

radiation safety measures and radiological waste management protocols. Knowledge and attitude alone were insufficient to ensure safe behavior. Private clinic owners, local dental bodies, and regulators should therefore implement minimum standards for assistant training, protective equipment, supervision, and environmentally safe disposal of radiological waste. Multidistrict studies with observational audits are recommended to guide broader policy development.

Ethics Approval and Consent to Participate

Ethical clearance was obtained from the Institutional Ethical Committee (Reference number: DMIMS(DU)/IEC/Dec-2019/8598). Written informed consent was obtained from all participants. Responses were collected confidentially and analyzed in aggregated form.

Data Availability

The data supporting the findings of this study are available from the corresponding author on reasonable request.

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