



RESEARCH ARTICLE

RADIATION SAFETY KNOWLEDGE AND PRACTICES AMONG PEDIATRIC DENTIST'S IN  
BENGALURU CITY- A CROSS SECTIONAL SURVEY

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ABSTRACT

**Introduction:** Intraoral radiographic examination is an inevitable and integral part of Pediatric dental practice. Long hours of practice in closed clinical set up and continuous exposure to negligibly low dose radiation on a long term basis pose a potential source of health hazard among Pedodontists. Hence optimization, dose limitation and radiation safety practice is very much essential for the protection of the child and the Pedodontist.

**Aim:** To determine the knowledge about radiation safety and to assess radiation safety practices undertaken by practicing Pediatric Dentists in Bengaluru city.

**Materials and methods:** A questionnaire survey was conducted amongst practicing Pediatric dentists in Bengaluru city. A questionnaire containing 29 questions was distributed among 80 Pedodontists in dental clinics and practicing academicians in various Dental colleges in Bengaluru to obtain information regarding demographic details, knowledge about radiation safety, and radiation safety practices. The responses were scored, the results were tabulated and subjected to statistical analysis

**Results:** From the study, it was found that 53% of the practicing Pedodontists had good knowledge on radiation safety. Female Pedodontists had better knowledge and radiation safety practices than males and Pedodontists seem to neglect radiation safety with increasing years of practice.

**Conclusion:** Despite having good awareness about radiation safety and the need for a radiation safe practice, Pedodontists in Bengaluru city have failed to implement the same in their routine clinical practice. Therefore by avoiding negligence towards radiation safety practice we can prevent the cumulative adverse effects of radiation.

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INTRODUCTION

Dental radiography is one of the most common diagnostic procedures in dentistry (Ataei *et al.*, 2013). Radiographs in pedodontic practice is inevitable and essential. They are valuable aids in the oral health care of infants, children, adolescents, and persons with special health care needs and are used to diagnose oral diseases, to monitor dentofacial development and the progress of therapy (Guideline on Prescribing Dental Radiographs for Infants, 2012). Obtaining diagnostic radiographs in the pediatric dental patient is probably the most difficult to accomplish, not only from a

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technical standpoint but because of parental fears and misconceptions. Unlike dentists in other specialties, radiation safety among Pedodontists is of concern as dealing with smaller age groups and lack of cooperation makes it difficult to follow the conventional safe radiation practice. The potential harmful effects of radiation on children is of concern because of the known greater radiosensitivity of children than adults (Radiation exposure in pediatric dentistry). Though the amount of radiation exposure encountered in dentistry is minimal, it can still bring about stochastic effects, that is, an all-or-none phenomenon. So, the prevailing approach is to keep the exposure to ionizing radiation as minimal as practically possible, according to ALARA principle (As low as reasonably achievable) (Gangavati *et al.*, 2016; Shahab *et al.*, 2012). Every effort should be made by the practicing Pedodontist to protect himself and also the child from the harmful effects of radiation.

Hence, good radiological practice (eg, use of lead apron, thyroid collars, and high-speed film; beam collimation) is very essential on a daily basis in private practice (Guideline on Prescribing Dental Radiographs for Infants, 2012). Closed clinical set up, busy practice and age oriented child management difficulties is seeming to be a leading cause of neglect towards radiation safety. Therefore, there is a need to determine the knowledge and radiation safety practices undertaken among the practicing Pedodontists.

## MATERIALS AND METHODS

The present study was a cross sectional survey conducted among practicing Pediatric dentists in the city of Bengaluru, Karnataka, India. A self-validated questionnaire consisting of 29 close-ended questions was formulated to obtain information regarding the knowledge about radiation safety, and radiation safety measures practiced among Pedodontists routinely in their clinics. Information pertaining to demographic data such as age, gender, duration of practice was also recorded. The questionnaire was distributed among 110 practicing Pedodontists in different areas of Bengaluru of which 80 responded. The questionnaire was given in person to Pedodontists in private clinics and to practicing academicians in various dental colleges in Bengaluru. The purpose of the study was explained to the Pedodontists, and the data was subsequently collected. The responses were scored, the results were tabulated and subjected to statistical analysis using chi square test.

**(Data analysis was conducted using SPSS ver 19 (PASW). Chisquare test was used to analyse the difference between categorical data)**

## RESULTS

### Case diagnosis and documentation

Majority i.e 94% of the Pedodontists took a detailed medical history of the child before exposing the child to radiation and also 81% of them had the habit of storing the radiographs for future reference.

### Radiographic equipment and maintainance

94% of the Pedodontists have conventional radiographic machine in their dental clinic, with 64% of the machines being installed in the last 5 years. 70% of the Pedodontists have the radiographic unit monitored regularly according to the manufacturers guidelines.

### Location of the radiographic equipment

64% of the Pedodontists have the radiographic unit placed next to the dental chair and only 36% of them have a separate radiographic room.

### Clinical Setup

Only 26% of the Pedodontists have got their clinical set up altered, as a dose reduction measure, either in the form of adequate thickness wall or leaded wall/ physical barriers with the remaining 84% of them either standing next to the dental chair or practicing distance rule position.

**Table 1. Distribution of study subjects based on Radiation safety knowledge and Gender**

	Good	Poor	Total	Chi square test
Male	22(41.51%)	14(51.85%)	36	P = 0.379
Female	31(58.49%)	13(48.15%)	44	
Total	53(100%)	27(100%)	80	

**Table 2. Distribution of study subjects based on Radiation safety knowledge and years of practice**

	Good	Poor	Total	Chi square test
≤ 5 years	25(47.17%)	18(66.67%)	43	P = 0.098
> 5 years	28(52.83%)	9(33.33%)	37	
Total	53 (100%)	27(100%)	80	

**Table 3. Distribution of study subjects based on Radiation safety Knowledge & Age**

	26-35 yrs	36-45 years	46-55 years	Total	Chi square test
Poor	17(62.96)	9(33.33)	1(3.7)	27 (100)	P = 0.548
Good	27(50.94)	22(41.51)	4(7.55)	53 (100)	
Total	44(55)	31(38.75)	5(6.25)	80 (100)	

**Table 4: Distribution of study subjects based on Radiation safety practice and gender**

	Good	Poor	Total	Chi square test
Male	19(52.77%)	17(47.22%)	36	P = 0.687
Female	28(63.63%)	16(36.36%)	44	
Total	47(100%)	33(100%)	80	

**Table 5. Distribution of study subjects based on Radiation safety practice and years of practice**

	Good	Poor	Total	Chi square test
≤ 5 years	30(69.76%)	18(66.67%)	43	P = 0.030P<0.05 significant
> 5 years	17(45.94%)	9(33.33%)	37	
Total	47(100%)	33(100%)	80	

Around 40% of them had put up sign boards indicating radiation prone zones and instructions for the female guardian to stay away from these zones if they are pregnant.

### Collimator and beam aiming devices

69% of the Pedodontists use collimators in their radiographic unit and about 43% of them are making use of beam-aiming devices.

### Radiographic film

Nearly 76% of the Pedodontists are making use of E or F speed films and the remaining 24% are still using the D speed films.

### Film Holder

74% of the Pedodontists were themselves in charge of taking radiographs in their clinic with 53% of them taking about more than 20 radiographs per day. Alarmingly, around 66% of the Pedodontists claim that they held the films by themselves in the child's mouth when necessary. However, on a regular basis where the child was old enough and cooperative 76% of the Pedodontists use film holders and around 60% of them preferred asking the accompanying person or the parent to hold the films in the child's mouth.

## Radiation protection of the patient and personal

61% of the Pedodontists in the study did not wear lead apron on themselves. 53% of them did not use lead apron on the child patients and about 78% of them never used a thyroid collar during radiographic exposures. About 26% of Pedodontists monitored the amount of radiation in their dental clinics through film badges.

## Radiographic waste disposal

Around 39% of the Pedodontists in the city of Bengaluru disposed the processing solutions, silver foils from radiographic films and other radiographic waste to silver refiners and 36% of them discarded it with the medical waste and around 25% of them disposed it with the general waste.

## DISCUSSION

Over the years many surveys have been conducted among the Dentists in different parts of the world to determine their knowledge and attitude towards radiation safety. However there is not enough data available regarding the same, among Pedodontists who deal with the younger group of patients who are more radiosensitive than their adult counterparts. This study mainly concentrates on the knowledge and radiation safety practices among Pedodontists of Bengaluru city. In the present study, majority of Pedodontists had fair to good knowledge regarding radiation safety with females and younger Pedodontists ie (26-35 years) having better knowledge and radiation safety practices. Specialization in the field of Pedodontics and also constant updating of knowledge through Continued Dental Education programmes (CDE) contributed to their knowledge. Nevertheless, many practicing Pedodontists were also academicians, which adds on to their knowledge score. This result is supported by the study done by Svenson *et al.* (1995), where participants attached to institutions had better knowledge and attitude scores than private practice alone.

However with increasing years of practice Pedodontists were found to neglect radiation safety practices which was also observed by Aravind *et al.* (2016) where dentists with >5years of practice had better awareness but scored poorly in their practices which can be correlated to the underestimation of the adverse effects of radiation. Epidemiological and laboratory studies reveal that exposure to low levels of radiation can bring about induction of cancer or cancer related cellular changes and also mark children more susceptible compared to adults to low level carcinogenic agents. (Richard W. Valachovic, Alan G, Lurie) Most Pedodontists in our study had a very good practice of taking detailed case history of the child before exposing them to radiation and also storing the radiographs for future use which can be attributed to their increased awareness of the risk associated with unnecessary re-exposures, medicolegal issues and also due to increased accessibility to computer softwares.

In India, AERB mandates that quality assurance tests of dental X-ray units should be carried out every 2 years by certified professionals (Smital, 2016). Majority of the Pedodontists in our study had conventional radiographic machines which were installed in the last 5 years which is comparable with the study done by Almas binal *et al.* (2017) and were monitored regularly based on the manufacturer guidelines, which is

comparatively a better practice than among general practitioners as seen in studies by Math *et al.* Shahab *et al.* and Gangavathi, *et al.* (2016; Shahab *et al.*, 2012; Math, 2013) This practice can be attributed to the ease of accessibility of services in Bengaluru city and the increased awareness towards radiation safety. It has been determined that digital imaging for intraoral radiography requires about half the exposure of E-speed film and produces images largely comparable with the film images and thus is an acceptable alternative (Smital, 2016). Few studies have reported higher number of dentists having upgraded to digital radiography (Smital, 2016; Agrawal *et al.*, 2015). However we found that only 16% Pedodontists used digital imaging which was also seen in various other studies among general dental practitioners (Shahab, 2012; Aravind *et al.*, 2016; Math, 2013; Sitra, 2008). This practice can be attributed to the higher cost of installation, lack of knowledge about the advantages of using digital sensors, also difficulty in usage of rigid film receptors with or without film holders in children when compared with the conventional flexible films.

Position, distance and shielding are the three important things while designing a radiographic room. The location of the x ray equipment should be such that the primary radiation should hit a shielded, partially shielded or an unoccupied area. Gypsum walls and building materials in the office offer protection against both primary and secondary radiation. Majority of Pedodontists in this study had the radiographic unit placed next to the dental chair with only 29 of them having a separate radiographic room as observed by Sitra *et al.* (2008) However, Aravind *et al.* (80.3%) and Kaur *et al.* (2015) (60.9%) reported higher number of dentists having a separate radiographic room (Aravind *et al.*, 2016; Kaur *et al.*, 2015). Small clinical space due to increased cost of living in Bengaluru can be attributed to not having a separate radiographic room in the clinical set up. Pedodontist's preferable placement of the radiographic unit next to the chair may be due to the ease of access, as a means of time management in the busy practice, frequent requirement of taking radiographs during endodontic procedures in children. Fewer Pedodontists had their clinical set up altered in the form of leaded walls/ adequate thickness of gypsum/ lead shields etc with majority of them following the distance position law, which is a similar practice observed among general practitioners in study by Math *et al.* (2013).

In the current study the number of Pedodontists having the radiographic unit next to the dental chair and practicing distance position law were significantly higher ( $P < 0.020$ ) in comparison to study done by Shahab *et al.* (36%) among the Iranian dentists and Aravind *et al.* (28.3%) among the general practitioners in Kerala (Shahab *et al.*, 2012; Aravind *et al.*, 2016). The most sensitive intra-oral film generally used in dental practice is E-speed film which results in a dose reduction of 40-50% when compared with D-speed. 76% of the Pedodontists are using E/F speed films with the remaining still using D speed. Similar results were seen in several other studies (Gangavathi *et al.*, 2016; Math *et al.*, 2013; Kaviani *et al.*, 2017). Collimators reduce the field of irradiation and are typically conical/circular or rectangular. Rectangular collimators are five times more effective at reducing the radiation dose compared to conical collimators. We observed that even though a larger group of Pedodontists used collimators, only 6% of them used rectangular collimators (Math *et al.*, 2017; Jacobs *et al.*, 2004; Ilguy *et al.*, 2005; Bohay *et al.*, 1994). Rectangular collimators require proper

positioning and angulation and are best when used with beam aiming devices. However Pedodontists prefer round collimators as they can avoid cone cut radiographs and re-exposures. 66% of the Pedodontists claimed that they hold films in the child's mouth using their fingers, when the age of the child and the behaviour of the child is compromised to use film holders, but not on a regular basis. 76% of the Pedodontists said that they made use of film holders which was also seen among general practitioners in several studies (Math *et al.*, 2013; Kaur *et al.*, 2015; Jacobs *et al.*, 2004). However Salti (43%), Shahab *et al.* (43%) reported reduced usage of film holders among dentists (Shahab *et al.*, 2014; Salti *et al.*, 2002). This practice may be attributed to the uncooperative behaviour of children which makes it difficult to follow conventional safe methods. Large cumbersome and inflexible sensors may also attribute to the decreased usage of film holders. Also, sheer negligence and underestimation of the cumulative effects of radiation on their fingers. Lead aprons are shielding apparel recommended for use by personnel who come in contact with the radiation. However, they provide protection only from secondary radiation and not the primary beam.<sup>15</sup> 61% of Pedodontists in their private practice did not wear lead apron and similar negligence was observed by Math *et al* and Sitra *et al.* (2008).

Though only 47% Pedodontists used lead apron on the child patient during radiographic exposure the practice seems to be better than the general practitioners as seen in several studies done by Math SY *et al*, Agarwal *et al*, Shahab *et al* and Aravind *et al* (0%) (Shahab *et al.*, 2012; Aravind *et al.*, 2016; Math, 2013; Agrawal *et al.*, 2015). Particular concern has been expressed over thyroid exposure during dental radiography as the gland is in close proximity to the dental x-ray beam and appears to have one of the highest radiation-induced cancer rates. 78% of Pedodontists in our study did not use thyroid collar on the children and similar practices were observed among general practitioners with almost none using as observed by Math *et al* and Agarwal *et al.* (Smital *et al.*, 2016; Math *et al.*, 2013; Agrawal *et al.*, 2015; Ilguy, 2005). A recent study by Johnson *et al* about intra-oral imaging risk reduction with collimation and thyroid shielding reported that round collimation with thyroid shield causes less dose reduction than rectangular collimation alone. In other words it implied that thyroid shield is not required if rectangular collimation is used (Johnson *et al.*, 2013). ADA council on scientific affairs encourages dentists to manage silver waste (in used fixer solution) and lead waste (used intraoral film packets, thyroid collars and lead aprons) through recycling. (Managing silver and lead waste in dental offices, 2003) Radiation waste disposal practice among Pedodontists of Bengaluru was found to be better with 38.8% of them disposing the waste to the silver refiners. However 36.3% of them disposed it with the medical waste and the remaining 25%, with the general waste. This practice can be attributed to increased awareness regarding environmental pollution and strict waste disposal norms introduced in the recent years.

## Conclusion

Over the years the negligence towards radiation safety remains an area of concern. Even with the increasing awareness about radiation related health hazards, radiation safety measures still remain unpracticed. Newer advances which aim at dose reduction are available in the recent times in which Pedodontists of Bengaluru city are trying to install. Radiation

safety of the children and the Pedodontists should be given prime importance in any clinical set up.

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