SURVEY OF THE CURRENT RADIOLOGIC PRACTICE AMONG GENERAL DENTISTS IN NORTH CAROLINA

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ABSTRACT

Deeba Kashtwari: Survey of the current Radiologic practice among General Dentists in North Carolina
(Under the direction of Ceib Phillips)

Objectives: This study assessed the status of current radiologic practice of general dentists in North Carolina. Also, it assessed whether years in practice, location of practice or graduation from the University of North Carolina-Chapel Hill School of Dentistry impacted how they practiced.

Methods: A survey was sent to a random sample of general dentists electronically twice using Qualtrics followed by a paper survey to the non-respondents.

Results: 74% of the dentists used digital radiography, 87% used round collimation and only 12 % used rectangular collimation. Paralleling technique and XCP was used by majority of respondents. In the last three years majority changed to digital radiography.

Conclusion: Years of experience and location of practice influenced the use of recommended practices. Methods to increased information along with publishing studies related to the subject would help in disseminating information to improve radiology practices**.** Continuing education courses should emphasize importance of implementing recommended practices.

This thesis is dedicated to the angels in my life, my two beautiful children Anasha Kaskar and Ahmad Ali Kaskar.
You are God's most precious gift to me.

For all these years there have been so many times when you needed me and I wasn't there.

Your smile takes all my worries away and you are my reason to live and be happy.

Mommy loves you so very much!

To my Husband who trusted me, stood by me and never let me give up.

To my parents who always dreamt big for me

To my brother who supported me throughout my journey.

To my in laws who kept praying for my success

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LIST OF ABBREVIATIONS

ADA	American Dental Association
ALARA	As Low As Reasonably Achievable Principle
CBCT	Cone Beam Computed Tomography
CCD	Charge couple device
CMOS	Complementary Metal Oxide Semiconductor
DA	Dental assistant
DH	Dental hygienist
FMX	Full-mouth radiographs
ICRP	International Commission on Radiological Protection
NC	North Carolina
NCAC	North Carolina Regulations for Protection Against Radiation
NCRP	National Council for Radiation Protection & Measurements
NEXT	Nationwide Evaluation of X-ray Trends
NVLAP	National Voluntary Laboratory Accreditation Program
PSP	Photo-stimulable phosphor
UNC	University of North Carolina

INTRODUCTION

Intra oral radiography is a very commonly used imaging modality and a source of radiation exposure. Dental x-rays comprise about 2.5% of the effective dose received from conventional radiographs and fluoroscopies for the United States population.[1] The updated International Commission on Radiological Protection (ICRP 2007) recommendations for calculation of effective dose included salivary glands, oral mucosa and extrathoracic airway tissues for the first time in the weighting scheme for radiosensitivity of tissues. In 2008, Ludlow et al in his study about the impact of the latest 2007 ICRP recommendations on patient risk considered effective dose related to common dental radiographic examinations thirty-two to 422 percent riskier than the effective dose calculated by using 1990 ICRP corresponding values. There is no definite proof that cancer is caused by radiation from dental radiography. However all the accredited organizations responsible for evaluating radiation risks warn that even low doses of radiation may conceivably cause harm and efforts should be made to decrease radiation exposure in adults and children.[2]

Dental x rays have become a public concern also due to their frequency of use. At least ten million x-rays were performed on children in 2010. The mortality risk of radiation-induced cancer in children is about three to five times more than adults due to their increased sensitivity to radiation. Moreover the greater risk to cancer occurs as dental procedures are repeated through the life span of an individual from childhood throughout life.[3]The lack of knowledge of the public and fear of danger or harm from radiation shown by the media and publications like the much criticized study with flaws that associated dental x-rays and the risk of meningioma further

highlighted the public fear of radiation exposure due to dental x rays.[4,5] Unless we have an affirmed threshold dose below which the patient has no risk, any amount of radiation is considered potentially harmful. It is very important to follow the "as low as reasonably achievable principle" (ALARA) and keep the exposures minimal by following standard radiographic practice safety measures.[6]

Updated guidelines on the use of x-rays for dental exposures were released by the American Dental Association (ADA), in collaboration with the US Food and Drug Administration, in 2012.These guidelines are not merely intended to serve as standards of care but were developed "to serve as an adjunct to the dentist's professional judgment of how to best use diagnostic imaging for each patient".[7, 8]

ADA guidelines consider it the dentist's responsibility to follow the ALARA principle after the decision to obtain radiographs is made. Proper utilization of recommended radiation practices in community based practices is vital for the safety of practitioners and patients. The American Dental Association and American board of Oral and Maxillofacial Radiology recommend the use of the fastest image receptors which include F speed film or digital receptors, beam limitation best achieved by rectangular collimation, use of personnel dosimeters and use of lead aprons and thyroid collars when possible.[7,8]

The transition to F-speed film can reduce exposure 20 to 50 percent compared to use of D-speed film, without altering diagnostic quality.[8,9] Radiation exposure can be further decreased significantly by using digital sensors or F-speed film in combination with rectangular collimation.[2,7] Digital radiography provides significant decrease in radiation dose to the patient with a comparable diagnostic quality to an F speed receptor[10]

BACKGROUND AND SIGNIFICANCE

Historically, compliance of dentists with radiographic guidelines has been low. Published surveys demonstrated that dentists do not comply with many recommendations which could help to lower dose reduction to the patient. In 1989, a survey of radiographic practices among dental practioners in a teaching hospital conducted by Arthur et al reported only 65% were using a film holding device and 60% of the practioners used a thyroid shield.[11] A survey conducted on a random sample of Michigan dentists in 1992 reported that only five percent used recommended rectangular collimation and that most dentists used only D-speed film. All the dentists used a lead apron and only 49% of them used a thyroid shield in adjunct with the apron[12]. Various other surveys conducted in Canada, Turkey, Iran, Greece, Switzerland and Uganda concluded that the standard of radiographic practice is low and ALARA is not followed.[13-18]

Several studies have indicated that even the dental schools are not following the recommendations for radiation protection appropriately. In 1986 Farman et al conducted a survey in North American Dental Schools and concluded that all dental schools did not follow ALARA because the schools were not using the methods available to minimize patient dose.[19] In 2002 a survey about radiation dose reduction techniques for North American Dental schools by Geist et al also showed that dental schools did not follow all the methods for dose reduction. Most of them did not comply with the ADA recommendations on film speed, collimation and use of thyroid shield.[20] Graduates from schools that use inappropriate practices may not adopt recommended practices in their private practice.

The literature also shows variation of radiographic practice among dentists with different years of experience. In 1994 Bohay et al reported that dentists who had graduated more than twelve years earlier were more likely to use rectangular collimation than recent graduates[13].

Giest et al in his study concluded that faculty dentists in practice fifteen years or less are more likely to use E-speed film than those who were in practice more than fifteen years.[20] A questionnaire to North American Dental schools to survey the dose reduction techniques used reported that only 47% used rectangular collimation and 85% used thyroid shields for intra oral radiography.[21]

Dentists need to update radiologic practices periodically for an adequate standard of oral health care. Studies have shown that the improvement in knowledge about radiation safety by attending continuing education programs can encourage dentists to change practices. Knowledge about radiation safety measures, risk and benefit to the patient and the operator, will reinforce adoption and implementation of a standard radiographic practice.[22]Periodic surveys of radiographic practices used in community based practices are essential to identify deficiencies and areas of weakness where dentists fail to follow ALARA in radiologic safety practices. These can then be addressed in continuing education courses and in dental school curricula to appropriately train graduates thereby benefiting the patient as well as the health care provider.

It is possible to achieve high quality diagnostic images along with reduced patient dose if dentists follow the regulations for standard radiographic practice which include well trained staff, shielding, faster image receptors and screen/film combinations, proper technique and recommended equipment.[3,7,8,9] Background on specific standards is provided below

Shielding:

The use of shielding according to ADA, NCRP and NCAC includes thyroid shielding and leaded aprons unless they interfere with diagnostic procedures. Use of a protective thyroid shield along with collimation for reduction of radiation exposure to the thyroid is emphasized but use of a lead apron is not necessary if all the recommendations for reducing radiation exposure are followed.[7, 23,24]

The support for the use of the thyroid collar is less clear.[7, 25, 26] Sikroski and Taylor in 1984 supported its use while Roth in 2006 concluded that use of a thyroid collar during dental x-ray examinations is not helpful for protecting the patient from unnecessary radiation exposure. Some studies showed an association of dental radiography during pregnancy with low birth weight.[27] However, a study in 2013 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 the thyroid shield is not required if rectangular collimation is used.[28]

Receptors and receptor holding devices

Currently available film speeds for intra-oral radiography are D-speed and F-speed in ascending order from slowest to the fastest. The fastest film speed consistent with the diagnostic purpose should be used to acquire images. (15A NCAC 11 .603(I) (i)).[7, 23, 29]

A survey of private practices in United States as a part of a nationwide evaluation of X-ray Trends (NEXT) program found that dental schools used E- speed films more often than private practioners.[30] Literature supports the use of fast speed receptors in radiographic practice instead of slow-speed film products that contribute to unnecessary increased exposure. [1, 7, 10, 29,30]Dental professionals are not allowed to hold the receptor holder during exposure. Heat sterlizable or

disposable receptor-holding devices aligning the receptor precisely with the beam are recommended for periapical and bitewing radiographs. Use of a receptor-holding device minimizes the risk of cone-cutting.[7]

Collimation:

Rectangular collimation of the beam should be used routinely for periapical radiography since the collimation decreases the radiation dose significantly in comparison with a circular collimator. The dimension of the beam should not exceed the dimension of the image receptor by more than 2% of the source-to-image receptor distance.[2, 7, 24]

Ludlow et al in 2008 reported effective doses (per the 2007 ICRP) in full-mouth radiographs (FMX) that indicated that microsieverts dosage is dependent on the receptor and collimation used. It was reported that FMX obtained with use of photo-stimulable phosphor (PSP) storage or F-speed film with rectangular collimation leads to an effective dose of 34.9 microsieverts; FMX by using a PSP or F-speed film with round collimation 170.7microsieverts and D-speed film and round collimation, 388 microsieverts. " This report signifies the need for use of fast speed receptor and rectangular collimation. [2] Hence dentists should use fast receptors and rectangular collimation in their practice to avoid unnecessary radiation exposure to their patients.

Dosimeters and personnel involved in image acquisition

The use of personal dosimeters to monitor exposure levels is recommended for employees who acquire radiographs (15A NCAC11 .0512).[23]ADA recommended dosimeter uses for employees who may receive an annual dose greater than 1 mSv and pregnant employees acquiring radiographs should use them no matter how minimal the exposure level.[7] The kind of

dosimeter should be evaluated by an accredited National Voluntary Laboratory Accreditation Program (NVLAP) (15A NCAC11 .0512).[23]

Technique used for intra oral radiography

Furhmann et al in 2006 published an article about problems and solutions of intra oral radiography and recommended use of only the paralleling technique. [31] Johan et al conducted a survey in 2010 to evaluate general dentistry practioners knowledge of dental radiology in Belgium: 81% reported use of parallel technique, whereas 14% mentioned use of bisecting angle technique and 5% were not aware of the technique they were using.[32]

An editorial review by Rohlin et al in 1992 concluded that a 10 to 20 times decrease in radiation dose is possible by making some changes that would be possible in every dental office. His review mentioned the possibility of 50% reduction in dose by using selection criteria, rectangular collimation and thyroid shielding and about 40% dose reduction just by switching to E speed versus D speed. [33]

In 1998 Platin et al surveyed dental radiographic quality assurance practices among North Carolina dentists. Not all dentists followed the recommended radiographic practice. Only 9% of the participants were using E-speed films and only 7.33% dentists used rectangular collimation.[34]

The purpose of this study was to identify current radiographic practices among general dentists in NC .This data will determine not only the change in practice since 1998 but will also allow us to identify areas of concern.

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INTRODUCTION

The American Dental Association (ADA), American Board of Oral and Maxillofacial Radiology (ABOMR) and North Carolina regulations for protection against radiation (NCAC) recommend dentists perform radiographic examinations using optimal radiographic techniques to achieve radiation safety and diagnostic image quality[1, 2, 3]. High quality diagnostic images along with reduced patient dose can be achieved if dentists follow the regulations for standard radiographic practice, which includes well-trained staff, shielding, faster image receptors screen/film combinations, proper technique and equipment optimization. ADA guidelines consider the dentist's responsibility to follow the "as low as reasonably achievable principle for radiographic practice (ALARA) prior to making the decision to obtain radiographs.[1]

A survey conducted on a random sample of Michigan dentists in 1992 reported that only 5% used recommended rectangular collimation and that most dentists used only D-speed film.[4] Platin et al conducted a survey .on North Carolina general dentists in 1998 with similar results. Nine percent of general dentists were using E-speed film and rectangular collimation was used by only 7.33% of the dentists.[5] Various other surveys conducted in Canada, Turkey, Iran, Greece, Switzerland and Uganda concluded that the standard of radiographic practice is low and ALARA is not followed.[6-11]

Several studies have indicated that even dental schools are not following the recommendations for radiation protection appropriately. In 1986, a survey of North American Dental Schools concluded that not all dental schools were following the methods available to minimize patient dose.[12] In 2002 a survey about radiation dose reduction techniques in North American Dental

schools again showed that most of the dental schools did not comply with the ADA recommendations on film speed, collimation and use of a thyroid shield.[13] Graduates from schools that use inappropriate practices may not adopt recommended practices in their private practice. Periodic surveys of radiographic practices used in community based practices are essential to identify deficiencies in radiologic safety practices that could be addressed in continuing education courses and in dental school curricula to appropriately train graduates. The objectives of this study were to assess the status of current radiologic practices of general dentists in North Carolina and to assess whether years in practice, location of practice or graduation from the University of North Carolina-Chapel Hill School of Dentistry impacted the choice of intra-oral receptor, collimation method, image acquisition techniques or method of shielding.

STUDY AIMS

The objectives of this study were to assess the status of current radiologic practices of general dentists in North Carolina and to assess whether years in practice, location of practice or graduation from the University of North Carolina-Chapel Hill School of Dentistry impacted the choice of intra-oral receptor, collimation method, image acquisition techniques or method of shielding.

MATERIALS AND METHODS

A survey instrument was developed with the assistance of The Odum institute at The University of North Carolina at Chapel Hill to assess current radiographic practices of general dentists in North Carolina. The project was approved by the University of North Carolina Biomedical Institutional Review Board. The questionnaire included 16 questions on the personnel who acquired images, shielding/radiation protection (use of dose monitoring devices,

lead aprons, thyroid shields), intra oral image acquisition techniques, equipment used for intra-oral radiography as well as location of practice, years of experience as a private practioners and dental school attended. The location of the practice was self-reported and no population criteria were given in the survey. The survey also included an open ended question asking about any technological changes or modifications that had taken place in past three years. As a pilot study, eight Operative Dentistry residents at The University of North Carolina School of Dentistry completed the questionnaires and provided feedback on the coherence and structure of the questionnaire.

A response rate of 35-40% was assumed. With the anticipated response sample size and the nominal scale of measurement of the outcome and explanatory variables of interest, a two-sided Chi-square test would have over 90% power at a 0.05 level of significance to detect a difference of 0.2 in the proportions of an outcome between two groups (for example urban vs rural).

A mixed mode distribution which included an electronic survey followed by a paper survey was used to conduct the survey to lower cost, save time and improve the response rate. A cover letter was emailed to each dentist who had an email address explaining the survey with an invitation to complete the online survey by following the link to the Qualtrics software. A reminder email with the link to the survey was sent out two weeks later to non-respondents. The dentists who did not have an email address and those who did not respond to either email invitation were mailed a cover letter and a copy of the survey created in Teleform (Cardiff Software, Vista, CA) with a postage paid return envelope. All electronic and paper surveys were numerically coded to maintain confidentiality and no personal information was collected on the survey. A linkage file was maintained to avoid any duplicate mailings and was destroyed at the

end of the study. Respondents who refused to complete the survey, were not in active practice or were practicing outside North Carolina were excluded from the sample.

STATISTICAL ANALYSIS

The primary outcomes of interest were whether personnel monitoring devices were used; type of receptor used (digital versus film); type of collimation used (rectangular versus round); and type of intraoral technique used (paralleling versus bisecting); and use of receptor holding device (XCP, stabs, snap a ray). Potential explanatory variables included years of experience, practice location and origin of dental school (UNC vs not UNC). Bivariate analysis was conducted using chi square statistics (SAS version 9.2). The level of significance for all analysis was set at 0.05.

RESULTS

Five hundred seventy three surveys (227 electronic and 346 papers) were returned. Twenty three were returned due to invalid addresses and 47 surveys were excluded because the practitioner was not in active practice. This yielded a response rate of 40% [n=503] of eligible respondents Seventy-five percent of the respondents worked full time defined as 33 hours per week. Fifty-two percent of the practitioners worked in urban areas and 58% were UNC graduates. (Figure1).

Multiple personnel performed image acquisition in the majority (72%) of practices. The most frequent combination of personnel was dental assistants and dental hygienists in 29.94% of practices followed by dental assistant (DA), dental hygienist (DH) and dentist in 28.40 % of the practices. Not all personnel who acquired images used monitoring devices. 28% of the dentists performing image acquisition used monitoring devices while 48.6% of the DA and 47.4% of the

DH who acquired images used dosimeters (Table 1). Ninety-three percent of the practices used a thyroid shield and apron but 7% used only a lead apron.

Most of the dentists (74%) reported using digital receptors, 14% used films and about 12% used both. Charge couple device (CCD) was the most commonly used digital receptor followed by Photo-stimulable phosphor (PSP) and complementary metal oxide semiconductor (CMOS) (Figure 2). Among those practioners who used films, 47% used D speed only and 52% used F speed film and about 2 % reported using both (figure 3). Years of experience were statistically significant related to the choice of receptors ($P =<0.001$). Dentists who had been in practice for 25 to 35 years were more likely to use film (Table2) and were more likely to use D speed film than F speed film. The choice of the receptor was also significantly related to the location of the practice ($p= 0.001$). Dentists practicing in urban areas were more likely to use digital receptors (81%) than the dentists practicing in rural areas (67%).

Eighty-seven percent of the practices used round collimation and only 12 % used rectangular collimation. Neither length in practice, practice location, nor school of graduation was statistically significantly related to the choice of collimation (Table 3). Paralleling technique was used by 33% of the practices and bisecting by five percent .Fifty-five percent used both paralleling and bisecting and six percent did not know the technique used. Type of technique used was affected by the years of experience ($p<0.001$) and school of graduation. Dentists in practice for 15 to less than 35 years reported both paralleling and bisecting techniques. Dentists who had been in practice for 35 years or more were more likely to use only paralleling technique. Non-UNC graduates more frequently reporting using “both” techniques while UNC graduates more frequently reported using “other”. A substantially higher percentage of those who had been in practice for less than 15 years reported using an “other” technique for image acquisition. The

location of the practice (p = 0.9) was not related to the choice of technique while the school of graduation (P= 0.05) was statistically significant. (Table 4)

The majority of practices used XCPs (Table 5) followed by stabes. Location (p=0.0001) and years of experience (p=0.02) were significantly associated with the choice of receptor holding device. Urban practices and dentists with less than 15 years of experience were more likely to use XCP.

About 38% of the practioners reported they made changes/ modifications in their radiologic practice in the past three years, primarily reporting conversion to digital radiography. Of the ALARA recommendations addressed in this survey, only four percent of the practices reported following all and 95% followed some of the guidelines.

DISCUSSION

Implementation of recommended radiation practices in community-based practices is vital for the safety of practitioners and patients. The American Dental Association and the American Academy of Oral and Maxillofacial Radiology recommend the use of the fastest image receptors which include F speed film and digital receptors, beam limitation best achieved by rectangular collimation, use of personnel dosimeters and use of lead aprons and thyroid shields when possible.[1,2]

The recommended use of shielding according to both ADA and NCAC includes thyroid shields and leaded aprons unless they interfere with diagnostic procedures. However, if all recommendations are followed for reducing radiation exposure, abdominal shielding is not considered necessary.[1, 3] The support for the use of the thyroid shields is less clear. Sikroski and Taylor in 1984 supported the use of thyroid shields while Roth in 2006 concluded that during dental x-ray examinations thyroid shields were not helpful for protecting the patient from

unnecessary radiation exposure.[14,15] A recent study 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.[16] The use of personal dosimeters to monitor exposure levels is recommended for employees who acquire radiographs (15A NCAC11 .0512). [3] The ADA recommends dosimeters for employees who may receive an annual dose greater than 1 mSv. Pregnant employees acquiring radiographs should use them no matter how minimal the exposure level is.[1] Not all personnel who were identified as acquiring images in this study reported using monitoring devices. Only 28% of dentists performing image acquisition used personal dosimeters. 48.6% of dental assistants and 47.4% of dental hygienists acquiring images used dosimeters. The responses in this study could not be used to indicate whether the use of monitoring devices was related to the frequency with which the person acquired images.

The use of F speed compared to D speed can reduce radiation exposure by about 60% percent without altering diagnostic quality.[17,18] Radiation exposures can be further decreased significantly by using digital sensors or F-speed film in combination with rectangular collimation.[1,2,3,9,20,21] Almost three quarters of respondents in this study used digital receptors. Dentists practicing in urban areas were more likely to use digital receptors (81%) than those practicing in rural areas. Dentists in practice the longest tended to use D speed film. In 1998, only 9% of NC general practice was using E-speed film and about 90% were using D speed film.[5] Compared to 1998 use of films has diminished drastically. Most dentists are using digital radiography, 14% reported use of films exclusively. Among those D speed film only was used by 36% and F speed film was used by 53% and nine percent reported use of both D and F speed film.

Rectangular collimation decreases the radiation dose significantly as compared with a circular collimation. Dentists can decrease the patient exposure by a factor of ten for bitewing and full mouth series by using digital sensors or F-speed film, combined with rectangular collimation [16, 22, 23]. Surprisingly 87% of the practices currently reported using round collimation while only 12 % used the recommended rectangular collimation. However, it is important to note that some dentists may be achieving this recommendation through the use of a circular collimator and receptor holding device that collimates the beam to the shape of the receptor (i.e. Precision Instrument, JadRad, etc.)

There are limitations of this study that should be considered in the interpretation of the data. First, the subject response rate was 40%.The response rate of this study is in line with other studies surveying a general dentist population. Second the location of the practice was self-reported by the dentists and had no set criteria for calling it rural or urban. Third there is no certainty that all the questionnaires were completed by the dentists themselves given that some respondents responded "none" or "don't know" for questions that they could reasonably be expected to know the answer. For example, six percent of the respondents didn't know the type of technique they used to acquire images and about 30% of dentists who used digital radiography did not know the type of receptor they used. It is unlikely that a dentist would be unaware of the type of technique used to acquire images. Fourth, the survey was designed to obtain overall practices for exposing radiographs. Specific questions related to pregnant women or children were not included and may have provided useful information. Fifth, dentists were questioned about lead aprons and cervical collars but not specifically for intra oral radiography or panoramic radiographs. The type of projection being exposed would have influenced the need for lead aprons and cervical/thyroid collars. Last, selection criteria and quality assurance protocols,

which are important factors contributing to reduction in radiation exposure, were not in the parameters of this study.

CONCLUSION

This survey showed that most dentists in the state of North Carolina reported using digital receptors and the use of D speed film has drastically declined. This was good news since the use of faster image receptors results in lower exposures to patients. However, the use of circular collimation remains high. Encouraging practitioners through education to use rectangular collimation will result in further exposure reduction to patients and improve image quality. Rectangular collimation reduces the scatter and secondary radiation exposure there by reducing fogging and improving contrast.[24]The survey also showed that the preponderance of respondents complied with the NC regulations for shielding patients during dental radiography examinations. Years of experience and location of practice influenced the use of recommended practices. Respondents who had been in practice the longest and urban respondents tended to use recommended practices less frequently. Methods to improve the knowledge of general dentists about radiation safety and dose reduction methods should be disseminated using various educational approaches and publishing studies related to the subject.[25]Additional studies are recommended to include the use of Panoramic and CBCT imaging methods. In addition collection of information should be considered through collaborative agreements with Radiation regulatory agencies.

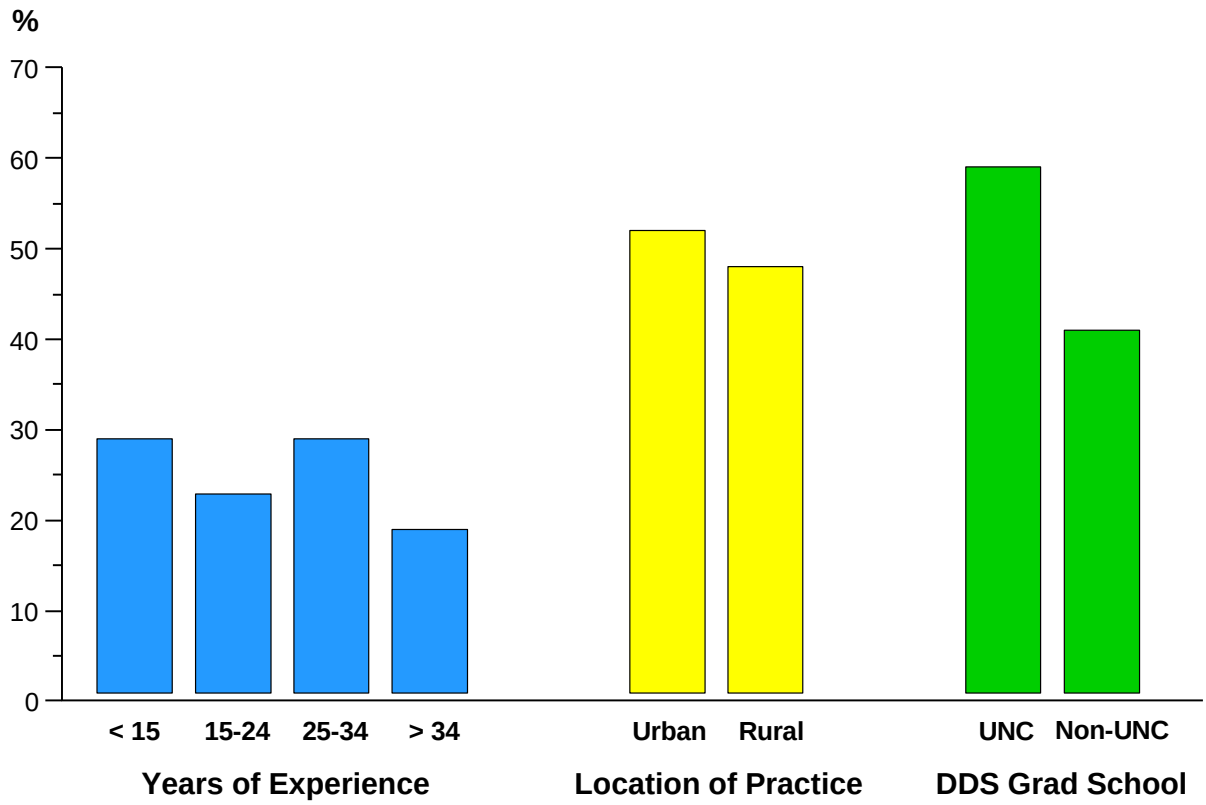

Figure 1: Over all distribution of the dentists according to years of experience, location of practice and graduate school attended

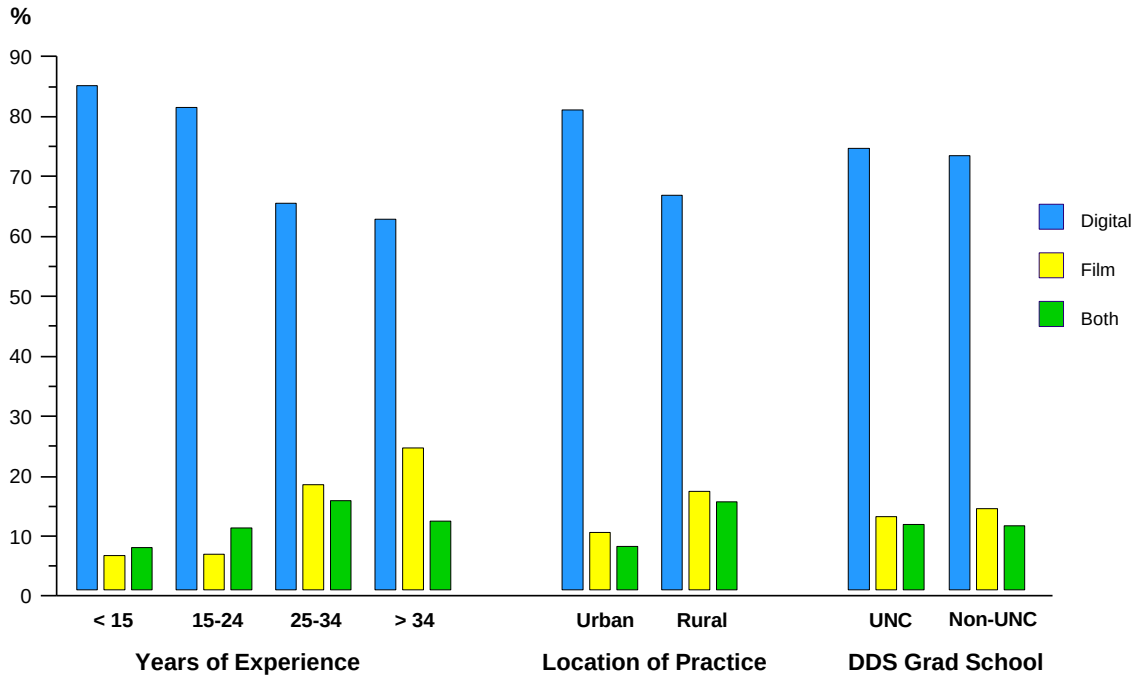

Figure 2: Receptor choice based on years of experience, location of practice and graduate school attended

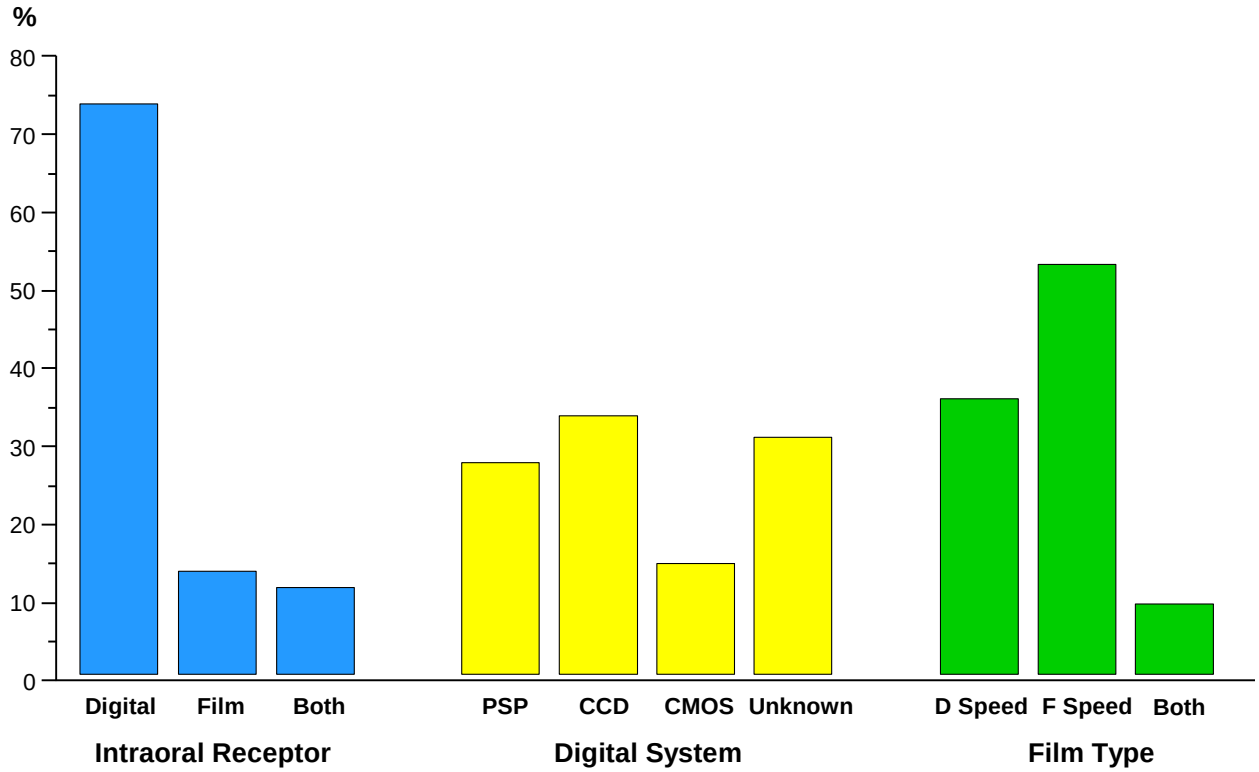

Figure 3: Percentage of practioners using digital and film radiography

Table 1: Percentage of personnel involved in image acquisition and using monitoring device

Role of person performing image acquisition	Acquires Image		Use of Monitoring Device	
	n	%	n	%
DA	414	79	201	49
DH	401	77	190	48
Dentist	226	43	64	28
Other	149	28	60	40

Table 2: Percentage of practices using digital radiography and film and their association with years of experience, location of practice and graduate school attended DDS Grad School

Use of Receptor	Digital		Film		Both		
Years of experience	n	%	n	%	n	%	P value
<15	126	85.14	10	6.76	12	8.11	<0.0001
15 to < 25	93	81.58	8	7.02	13	11.40	
25 to < 35	95	65.52	27	18.62	23	15.86	
>= 35	61	62.89	24	24.74	12	12.37	
Location							
Urban	215	81.13	28	10.57	22	8.30	0.001
Rural	161	66.80	42	17.43	38	15.77	
DDS Grad school							
UNC	219	74.74	39	13.31	35	11.95	.91
Non-UNC	156	73.58	31	14.62	25	11.79	

Table 3: Percentage of the types of collimation used and their association with years of experience, location of practice and graduate school attended.

Type of collimation	Rectangular		Round		Other		
Years of experience	n	%	n	%	n	%	P value
<15	22	15.49	120	84.51	0	0.00	.23
15 to < 25	8	7.02	104	91.23	2	1.75	
25 to < 35	16	12.03	115	86.47	2	1.50	
>=35	11	11.58	84	88.42	0	0.00	
Location							
Urban	27	10.55	228	89.06	1	0.39	.36
Rural	30	13.04	197	85.65	3	1.30	
DDS Grad school							
UNC	33	11.79	244	87.14	3	1.07	.78
Non-UNC	24	11.71	180	87.80	1	0.49	

Table 4: Percentage of the types of image acquisition technique used and their association with years of experience, location of practice and graduate school attended

Technique used	Parallel		Bisecting		Both		Other		P value
Years of experience	n	%	n	%	n	%	n	%	
<15	51	34.93	9	6.16	63	43.15	23	15.75	<.0001
15 to < 25	29	25.22	5	4.35	77	66.96	4	3.48	
25 to < 35	50	34.25	9	6.16	84	57.53	3	2.05	
>=35	36	36.73	4	4.08	57	58.16	1	1.02	
Location									
Urban	90	34.09	15	5.68	143	54.17	16	6.06	0.90
Rural	77	31.69	12	4.94	138	56.79	16	6.58	
DDS Grad school									
UNC	98	33.11	15	5.07	15	53.04	26	8.78	.05
Non-UNC	69	32.86	12	5.71	123	58.57	6	2.86	

Table 5: Percentage of the receptor holding devices used and their association with years of experience, location of practice and graduate school attended

Use of Receptor holding device	XCP		Stabes		Snap a ray		More than 0ne		Other/None		
Years of experience	n	%	n	%	n	%	n	%	n	%	P value
<15	89	62.24	7	4.90	2	1.40	42	29.37	3	2.10	
15 to <25	61	55.45	9	8.18	1	0.91	32	29.09	7	6.36	0.0001
25 to <35	52	37.96	22	16.06	7	5.11	54	39.42	2	1.46	
>= 35	34	40.48	14	16.67	2	2.38	27	32.14	7	8.33	
Location											
Urban	140	54.90	18	7.06	6	2.35	80	31.37	11	4.31	
Rural	96	43.64	34	15.45	6	2.73	76	34.55	8	3.64	0.02
DDS Grad school											
UNC	129	46.74	35	12.68	6	2.17	93	33.70	13	4.71	
Non-UNC	106	53.54	17	8.59	6	3.03	63	31.82	6	3.03	.39

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APPENDIX 1: SURVEY OF THE CURRENT RADIOLOGIC PRACTICE AMONG GENERAL DENTISTS IN NORTH CAROLINA

UNC Department of Oral and Maxillofacial Radiology

Survey of the Current Radiologic Practice Among General Dentists in North Carolina

ID #: ☐☐☐☐

Directions: Please make sure to answer all of the following questions. Choose only ONE response per question unless indicated otherwise. Use a BLACK BALLPOINT PEN to fill in the circles completely for your response.

Completion of the questionnaire will be considered as consent to participation.

1. **Do you actively practice as a general dentist in the State of North Carolina?** ○ Yes ○ No
   If "No", thank you for your time. Please return the survey.

2. **Approximately how many hours per week do you practice?** ☐☐ hrs/week

3. **Who performs image acquisition in your practice? (select ALL that apply)**
   ○ Dental Assistant ○ Office trained assistant with radiology certification ○ Dental Hygienist ○ Dentist

4. **Which of the following is used in your practice?**
   ○ Thyroid shield ○ Lead apron ○ Thyroid shield and lead apron ○ None

5. **Who in your practice uses radiation dose monitoring devices? (select ALL that apply)**
   ○ Dental assistant ○ Office trained assistant with radiology certification ○ Dental Hygienist ○ Dentist ○ None
   If "None" is selected SKIP to question 7

6. **What kind of personnel dosimeter is used in your practice?** _____

7. **Which of the following intraoral receptors is used in your practice?**
   ○ Digitial receptors ○ Films ○ Both ***If only "Films" is selected SKIP to question 9***

8. **What type of digital system do you have? (select ALL that apply)**
   ○ Photostimulable phosphor plates (PSP) ○ Charged couple device (CCD)
   ○ Complementary metal oxide semiconductors (CMOS) ○ Don't know

9. **What time of film do you use? (select ALL that apply)** ○ D speed ○ F speed

10. **What type of collimation do you use in your practice?** ○ Rectangular ○ Round

11. **Which technique do you use to acquire your intraoral radiographs?** ○ Paralleling ○ Bisecting ○ Both ○ Don't know

12. **Which receptor holding device do you use in your practice?** ○ XCP ○ Stabes ○ Snap A Ray ○ Other ○ None

13. **Have you made any technological changes/modifications in your intraoral radiography in the past 3 years? If yes, please state.** ○ Yes ○ No
    _____

14. **Years of experience as a private practitioner:** ☐☐ yrs

15. **Location of primary practice:** ○ Rural ○ Suburban ○ Small town ○ Other

16. **DDS Grad School:** ○ UNC ○ Non UNC