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Utilization of Rectangular Collimation in Dental and Dental Hygiene Programs

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Utilization of Rectangular Collimation in Dental and Dental Hygiene Programs

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Abstract

Rectangular collimation has proven to reduce the radiation dose to the patient as well as increase image quality. Studies have been conducted in the past to determine whether utilization of rectangular collimation results in a greater retake rate, however, there is a lack of data regarding the amount of rectangular collimation devices that are currently in use. The purpose of this study was to determine to what extent, if any, rectangular collimators are being utilized in dental and dental hygiene programs. A survey was created and sent via email to the program directors of Accredited dental and dental hygiene programs. A total of 97 programs responded to the survey, however 16 of those surveys were not completed. To be included in the data analysis, question number one (which program do you represent, dental or dental hygiene) must have been answered. Eighty-nine responses qualified, of those, 6 were dental programs and 83 were dental hygiene programs. The results determined that the majority of the programs teach about rectangular collimation in the didactic portion of the radiology course, but do not use a rectangular collimation device during patient care.

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Utilization of Rectangular Collimation in Dental Hygiene Programs and Dental Programs

Introduction:

Dental radiographs play an essential role in the diagnosis of oral disease and are necessary to provide comprehensive treatment for each patient. The safety of dental radiographs and x-radiation exposure can be a concern for dental patients. As such, patient safety and quality diagnostic images should be a goal of every dental provider. One way to achieve both of these goals is with the use of collimation. Collimation restricts the size and shape of the x-ray beam. Restricting the size and shape of the x-ray beam results in reduced patient exposure to x-radiation and increased image quality.

In dental radiography, there are three types of image receptors; traditional film, phosphor storage plates (PSPs) and charged-couple devices (CCDs). PSPs and CCDs are both forms of digital radiography. All three image receptors are rectangular in shape and come in different sizes. The size 2 is the most common size for intraoral radiography. A Position Indicating Device (PID), also known as a Beam Indicating Device (BID), is a portion on the tube head of the x-ray unit that is used to align the x-ray beam with the examination site. It also restricts the dimensions of the dental x-ray field by limiting the size and shape of the primary x-ray beam. PIDs come in two shapes, round and rectangular. A round PID with a collimator diameter of 6cm is approximately 135% larger in area than the traditional size 2 (1 ¼" x 1 ⅝") image receptor.[8] This results in a large part of the patients' orofacial area being exposed to unnecessary radiation.

Rectangular collimation further restricts the x-ray beam to about the size of a traditional size 2 image receptor consequently reducing the surface area exposed to x-radiation. Rectangular collimation has proven to decrease the radiation dose to the patient by up to 70%. [1]

Along with a reduction in patient exposure, use of rectangular collimators can increase image quality. This occurs because there is less scatter radiation. Scatter radiation is a result of x-ray interaction with any object, including body tissues. A decrease in the area exposed to x-radiation results in less scatter radiation production. This in turn creates a higher image quality. For a radiograph to have high image quality, it must have the appropriate contrast or degree of black and white, and proper density or level of lightness or darkness. The scatter radiation that occurs when using a round collimator can negatively affect both contrast and density by creating "noise" or "fog". [1] This "noise" creates an image that appears grainy, a salt and pepper appearance. The use of rectangular collimation decreases the patient's dose and increases image quality, benefitting both the patient's health and the provider's ability to accurately diagnose oral diseases.

To achieve the highest quality of standards, it is vital for dental and dental hygiene programs to educate and train students using the safest most effective tools available. According to Saadika (2014), the process of learning begins in the classroom and is then implemented in the clinical setting. The patient-oriented approach utilized in dental programs assumes that there is continuity in applying the best evidence from classroom teaching to clinical practice. Therefore, learning radiographic technique with rectangular collimation while in school may encourage providers to continue their use in practice after graduation.

Statement of the Problem:

Studies have shown that using rectangular collimation as opposed to round collimation when taking dental radiographs provides specific benefits. There is also literature to support that because of these benefits, it is recommended that rectangular collimation be used in every dental practice, including dental and dental hygiene programs. However, the question exists, are dental and dental hygiene programs educating on the benefits of rectangular collimation as well as utilizing rectangular collimation devices during patient care?

Significance of the Problem:

Dental radiographs are a crucial part of comprehensive dental care. Radiographs provide information that cannot be seen clinically or with direct vision. A good quality radiograph can show the dental provider anatomy and pathology of the periodontium such as, but not limited to, alveolar bone loss, the location of the bone loss as well as the pattern of the bone. They are also critical in identifying other pathologies such as dental caries. Oral pathologies, if undetected, can advance in severity and progress to other areas. High quality imaging is vital in order to detect, diagnose, and properly treat disease.[2] Improving diagnostic image quality allows changes to be seen more precisely and may help improve practice decisions.[12] High quality imaging also facilitates early detection and diagnosis, which is key to prevent the need for more invasive therapies or the result of a hopeless prognosis. For these reasons, it is imperative that the highest quality radiographs be obtained while still maintaining patient safety.

X-rays are a form of ionizing radiation. This means that when they interact with patient tissues ionization occurs. Ionizations can cause Compton scatter or photoelectric effect. Compton scatter breaks apart a neutral atom and creates a positive atom and a dislodged negative electron.

The negative electron then interacts with other atoms in the tissue, resulting in further ionization, excitation, or breaking of molecular bonds. This can cause chemical changes within the cell that result in biological damage.[6]

All cells are composed of a nucleus and surrounding cytoplasm. If ionizing radiation damages the nucleus, the chromosomes containing DNA will be disrupted. This can cause change in cell function or even cell death. However, not all cells respond to radiation in the same way. Some are radiosensitive and some are radioresistant. Radiosensitive cells include blood cells, reproductive cells, lens of the eye and oral mucosa. Radioresistant include cells of bone, nerve and muscle.[6] Because dental imaging exposes several of these areas, and ionizing radiation can be harmful to living tissues, it is important that radiographs only be taken when the benefit of disease detection outweighs the risk.

The dental professional has the responsibility to protect their patients and adhere to the concept of ALARA. This stands for As Low As Reasonably Achievable. ALARA came about in 1974, it was created and enforced on a federal level by the Nuclear Regulatory Commission.[16] To comply with ALARA, there are several tools the dental professional can use. These include appropriate receptor selection, correct exposure technique, proper use of shielding and collimation. Receptor selection includes using high speed film or digital radiography. There is a significant decrease in the exposure technique when switching from film to digital radiography. For example, if an exposure setting of 16 is used for anterior teeth with film, it can be lowered to an exposure of 8 when using a digital sensor. This results in a mean exposure reduction to the patient of about 55%.[18]

Combining digital radiography with rectangular collimation significantly decreases radiation exposure. Granlund et al conducted a study to determine the radiation dose a patient

receives from a full mouth series of radiographs. A full mouth series consists of 18-20 x-ray exposures. Their study compared the use of phosphor storage plates (PSPs) with rectangular collimation to D-speed film using circular collimation. The results of this study showed that the effective dose received from a full-mouth examination, using PSP exposure factors and rectangular collimation is 15 μSv. In another study conducted by White, the average effective dose from using D-speed film and circular collimation was found to be 84 μSv.

The majority of x-ray tubes in dental offices have a round position indicating device or cone. However, the image receptor or sensor is a rectangle. This results in an unnecessary amount of radiation interacting with the patients' tissue. An increase in tissue interaction increases the amount of scatter radiation. Scatter radiation decreases the sharpness of the image and increases the patients' absorbed radiation dose. Using a rectangular collimator instead of a circular collimator greatly reduces the amount of scatter radiation. Studies have shown that rectangular collimation reduces radiation exposure and absorbed radiation dose up to 70%.[1]

As a licensed professional, it is the dental hygienists responsibility to provide safe patient care and deliver the best quality diagnostic images. A rectangular collimator is a tool that can be used to decrease the radiation dose to patients as well as increase the quality of the images for the dental provider.

Operational Definitions:

Position Indicating Device (PID)- A device used to align the x-ray beam with the examination site and to restrict the dimensions of the dental x-ray field by limiting the size and shape of the primary x-ray beam. Also known as a cone or a Beam Indicating Device (BID)

Collimation- The restriction of the size and shape of the x-ray beam in order to reduce patient exposure.

Compton Scatter- When an x-ray photon collides with an outer shell electron and gives up part of its energy to eject the electron from its orbit. The x-ray photon then loses energy and continues in a different direction at a lower energy.

Ionization- The production of ions, the process of converting an atom into an ion, resulting in the formation of a positive atom and a dislodged negative electron.

Radiograph- An image or picture produced on a receptor by exposure to ionizing radiation.

Scatter Radiation- Radiation that spreads out in different directions from the radiation beam when the beam interacts with a substance such as body tissues.

X-Radiation- A beam of energy that has the power to penetrate substances and record image shadows on receptors.

Chapter 2: Review of Literature

Introduction

To deliver the best possible care, dental providers must have a comprehensive patient assessment. This includes a health history, vital signs, an oral cancer screening, periodontal evaluation and dental radiographs. Without dental radiographs, the provider is unable to comprehensively determine a patients' oral health or disease status. While there are many anomalies the provider can visualize directly, some pathology and anomalies such as periodontal diseases, abscesses and dental caries can often only be visualized with the use of radiographs. For this reason, it can be difficult to provide a diagnosis and a treatment plan without obtaining quality radiographic images.

Because radiographs are a crucial part of a patient's assessments, it is imperative that the highest quality images be obtained while still providing the maximum level of patient safety. Appropriate collimation is one way to achieve this goal. This literature review will discuss the importance of rectangular collimation and the benefits of using it on every patient. It will include the allotted radiation doses for the general public, and the effect radiation has on the tissues with which it interacts. Rectangular collimation and why it benefits the patient, why it benefits the provider, how to convert conventional x-ray units and concerns about using rectangular collimation will be discussed. Studies that have been conducted about the use of rectangular collimation will also be included.

Along with dental hygiene and radiology textbooks, PubMed and MeSH databases were used to gather information about this topic. "Radiation safety," "dental radiographs," "collimation" and "rectangular collimation" were some key words that were used.

X-Radiation

The International Commission on Radiation Units and Measurements (ICRU) has established units to measure radiation. These include the Coulombs/kilogram (C/kg), the Gray (Gy) and the Sievert (Sv). Each unit is used for a specific radiation measurement. C/kg measures the number of electrical charges or the number of ion pairs in the air, Gray measures the amount of energy absorbed by the tissue and Sievert is used to compare the biologic effects of different types of radiation.

In dental radiography the salivary glands, the thyroid gland and the oral mucosa receive the highest doses of radiation. The maximum permissible dose (MPD) for the general public is 0.001 Sv/year or 1000 µSv.[6]

Type	**Average Effective Dose (Adults) in Millisieverts**	**Equivalent Effective Dose (Adults) in Microsieverts**
Intraoral X-ray	0.005mSv	5.0 µSv
Dental Panoramic radiography	0.01mSv	10µSv
Chest x-ray	0.1mSv	100µSv
Dental computed tomography	0.2mSv	200µSv
CT scan (chest angiography)	12mSv	12,000µSv

Source: Iannucci, 2017

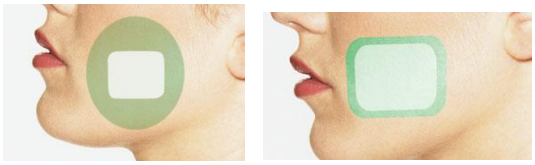
X-radiation has an effect on all cells with which it interacts. This interaction can cause damage to the cell nucleus, the cytoplasm or the entire cell. This damage can lead to cell death or dysfunction. There can be somatic effects, which are seen in the person directly irradiated. These can include cataracts, cancer and leukemia. Somatic effects will not be passed along to future generations. There can also be genetic effects, which are seen in the offspring of the person irradiated, and not the person themselves. These can include congenital malformations

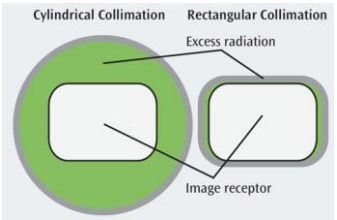
and spontaneous abortions.[6] Use of proper safety precautions in dental radiography will prevent these effects from occurring.

Rectangular Collimation

Dental x-ray units consist of several parts. There is the control panel, arm, yoke, tube head and positioning indicating device (PID). Inside the PID there is a lead collimator. The collimator is used to restrict and thus reduce the size of the x-ray beam. The majority of PID's are circular in shape while the image receptor is rectangular. This means that the area of the x-ray beam is much larger than the area of the receptor which, results in the beam interacting with the surrounding tissues. Interaction with any object creates scatter radiation, therefore the larger the amount of tissue being irradiated; the more scatter is created. Scatter in turn degrades the quality of the image. Reducing excessive scatter radiation by narrowing the beam increases image contrast and reduces noise/fog (gray film). [1]

The diagram below demonstrates the difference in the size of the radiated area when using a round collimator versus a rectangular collimator.



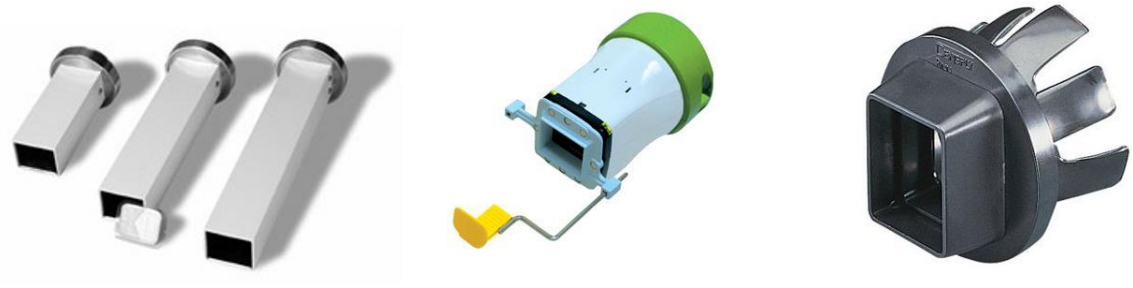


Source: https://dimensionsofdentalhygiene.com/article/reduce-radiation-with-rectangular-collimation/

In dentistry the most common size intraoral image receptor is rectangular in shape with dimensions of 41mm x 31mm. The average diameter of a round collimator is 7cm, which creates an exposure area three times the size of the image receptor. Some newer machines are equipped with a 6cm circle which still creates an area twice the size of the receptor. When patients are exposed with a round collimated beam instead of a rectangular beam, they are exposed to at least 2 times more radiation than is needed. One study conducted at the University of North Carolina revealed that the use of a rectangular collimator insert rather than a 6cm diameter round cone collimator reduced the effective radiation dose by 40% in a child phantom.[7]

Conversion

As previously discussed, most dental x-ray tubes are equipped with a round PID. However, there are many options to easily convert the standard unit to a rectangular collimator. The following images are some examples of kits that can easily be attached to a conventional round PID:



Source: https://www.dentalcompare.com/Dental-Digital-Imaging-Dental-Imaging/5072-Rectangular-Collimator/

Rectangular collimation restricts the size of the x-ray beam. Utilizing a rectangular collimation device exposes 70% less tissue volume than round collimation, which causes a decrease in the effective dose to the patient roughly fivefold. Additionally, rectangular collimation reduces scatter radiation which improves image quality. Devices that provide

rectangular collimation include rectangular collimators that attach to round PIDs, metal rings that clip into the instrument beam guide, or facial shield collimators that are incorporated into receptor-holding instruments.[18]

Concerns

While there are easy solutions to convert from circular collimation to rectangular collimation, many providers are hesitant to make the change. One of the main concerns with using rectangular collimation is the risk of missing anatomy due to the restricted beam, which may require retaking images.[5] It can be argued that with a smaller beam size there is a higher risk of producing cone cut on the image. Cone cut is when the beam is not correctly aligned with the image receptor resulting in an area that was not exposed. This area appears radiopaque or white and provides no diagnostic information. To address this concern, there are devices, such as the RINN XCP © system, that aid in correctly aligning the beam and the receptor.

According to Castellanos 2013, cutoff errors may occur more frequently when a rectangular collimator is being used, however these errors were often a result of poor technique. Furthermore, these radiographs were diagnostic and retakes were not required. Harrison, 2013, also found that while errors do occur more often with the use of rectangular collimators, they do not result in a loss of diagnostic information and therefore do not need to be retaken.

Studies

A systemic review was conducted by Shetty et al. that analyzed previous studies which compared rectangular collimation to round collimation. They found thirteen articles that met the inclusion requirements for their study. These included studies conducted on cadavers, phantoms and patients. The author of this study states that the International Council on Radiation Protection (ICRP) updated the basis for radiation safety in 2012. This update included the assignment of tissue weighted values to the salivary glands and oral mucosa for the first time since 1977. The findings of their study determined that using a rectangular collimator provided on average at least a 40% reduction in radiation dose, complying with the new ICRP standards.

This study also determined there is an indication that using a rectangular collimation device reduces the exposure to the thyroid more than a round collimator used in conjunction with a thyroid shield.

Retake rates for dental and dental hygiene students using rectangular collimation were assessed is another qualifying study. The results showed an 11% re-exposure rate for dental students and a 6% re-exposure rate for dental hygiene students. However the majority of the retakes were due to improper placement of the image receptor and not the placement of the rectangular collimation device. These low retake rates show that implementing rectangular collimation devices in the educational setting is feasible.[9,14]

However, Shetty et al. reference a study from 2001 stating that 65 dental schools across North America responded to a survey querying about the use of rectangular collimation devices in their programs. The results of that survey showed that only 47% use rectangular collimation while 52% use round collimation. [3]

Another study was conducted comparing rectangular and circular collimators in a UK military dental practice. Three time-framed subsets, each consisting of 1000 bitewing radiographs, were used. The first subset were images taken using circular collimation with no receptor holding device. The second subset were images taken using circular collimation with a receptor holding device. The third subset were images taken using rectangular collimation and a receptor holding device.

The results showed that there was a decrease in cone cut errors from 21.7% to 3.3% when a receptor holding device was used with a round collimator. When the rectangular collimator was used, the cone cut errors increased from the 3.3% to 20.9%. However, the number of radiographs that required the image to be retaken was only 0.3% or 3 in 1000 films.

This study offers evidence that rectangular collimation did not significantly affect the diagnostic quality of bitewing radiographs, even though cone cuts were present.[10]

Conclusion

The National Council of Radiation Protection (NCRP) published a report in December 2003 (NCRP Report # 145) and states in part: Rectangular collimation of the beam shall be used for periapical and interproximal bitewing radiography.[11] Undoubtedly rectangular collimation has been around for several decades; however, it is unknown how often rectangular collimation is taught and used in dental and dental hygiene programs.

Chapter 3: Methods and Materials

Introduction

For this study, a survey was sent to the directors of dental hygiene programs and dental programs accredited by the Commission on Dental Accreditation. The survey included multiple-choice questions pertaining to the use of rectangular collimation devices in their programs. The results of this survey evaluated what extent rectangular collimators are being used in the educational setting. It also sought to answer the question of why they are not being used, if that was the case.

Hypothesis

Rectangular collimators are not being used in the majority of dental hygiene and dental programs. The most likely reasons are lack of knowledge about rectangular collimation devices and fear that they may be difficult to use.

Sample Description

The sample population for this study included 340 accredited dental hygiene and dental programs in the United States. The survey was sent to the director of each program via email and they were asked to pass the survey along to the Radiology course and lab coordinator. The contact information was obtained from the American Dental Hygienist Association (ADHA) and the American Dental Association (ADA) websites. Programs not listed on these websites were not included in this study.

Research Design

This was a descriptive study, using an online survey to obtain quantitative data about rectangular collimator usage. The survey was created using the online software service called Red Cap. Upon approval from the university's Human Research Protection Office (HRPO) (Study ID 18-683), the surveys were sent via email to the previously mentioned dental hygiene programs and dental programs.

The questions on the survey were multiple choice. Some multiple-choice questions had further branch questions dependent on a yes or no response. The survey questions aimed to determine if rectangular collimation devices are being used in the educational setting. What type/brand of collimators are the programs using? How long has their program been using rectangular collimation devices? If rectangular collimation devices are not being used, what are the barriers or concerns preventing their use. For example, was it cost of conversion or fear of poor image quality?

The survey was available to the Radiology course and lab coordinators for two weeks. At the end of the two-week time period, the survey was closed and the data was compiled and analyzed.

Data Collection and Analysis

A population test was done to determine the rate of responses from both the dental and dental hygiene programs. Fisher's Exact tests were used to analyze survey responses between the two cohorts ($P = .05$).

Chapter 4: Results, Discussion and Conclusion

Results

The survey was sent out on November 12, 2018 and remained open for two weeks, closing on November 26, 2018. A total of 97 surveys were received. To be included in the data analysis, question number one, asking the respondents to identify which type of program they represented (dental or dental hygiene) must have been answered. A total of 8 programs did not answer this question. Therefore, the overall response rate used was 26% (N=89) while the individual response rate from dental programs was 7% (n=6) and dental hygiene programs was 93% (n=83). (Figure 1)

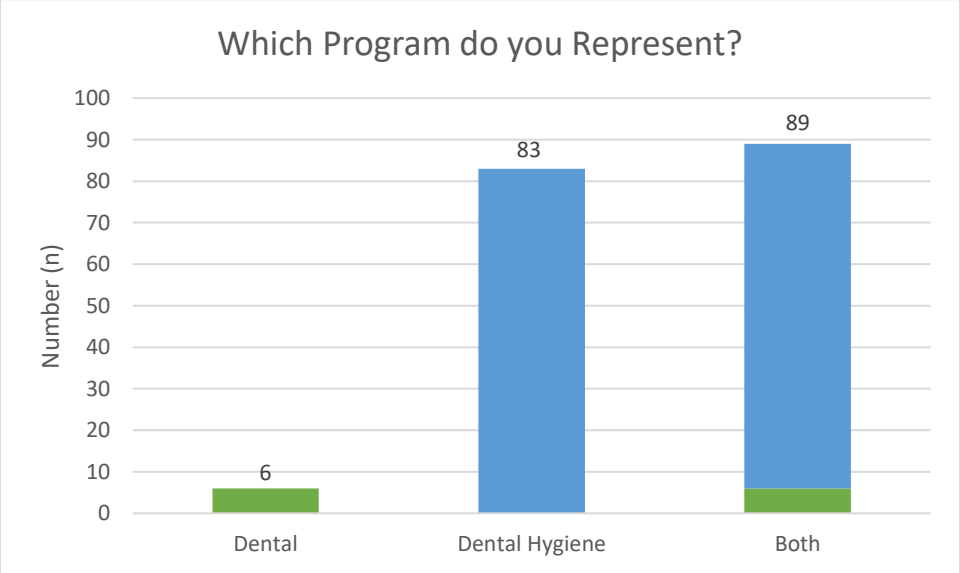


Figure 1. Type of program represented (dental or dental hygiene)

The second question queried whether rectangular collimation was taught in the didactic portion of the radiology course. The number of dental programs that responded yes was 100% (n=6) and no was 0% (n=0). The number of dental hygiene programs that responded yes was 96% (n=80) and no was 1% (n=1). Submissions that did not answer this question were 3% (n=2) (Figure 2)

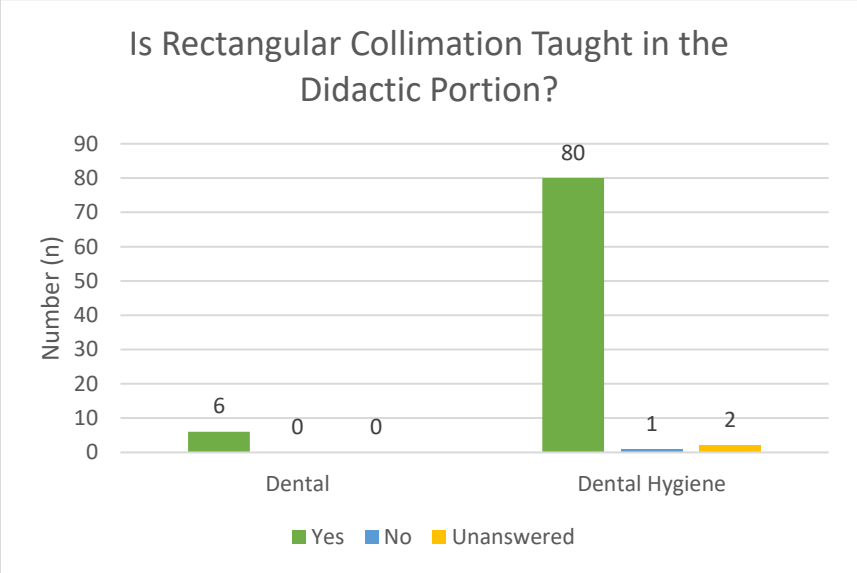


Figure 2. Rectangular collimation taught in didactic portion

Question three enquired if rectangular collimation was taught during the lab portion of the radiology course. The number of dental programs that responded yes was 83% (n=5) and no was 17% (n=1). The number of dental hygiene programs that responded yes was 37% (n=31) and no was 60% (n=50). Submissions that did not answer this question were 3% (n=2) (Figure 3)

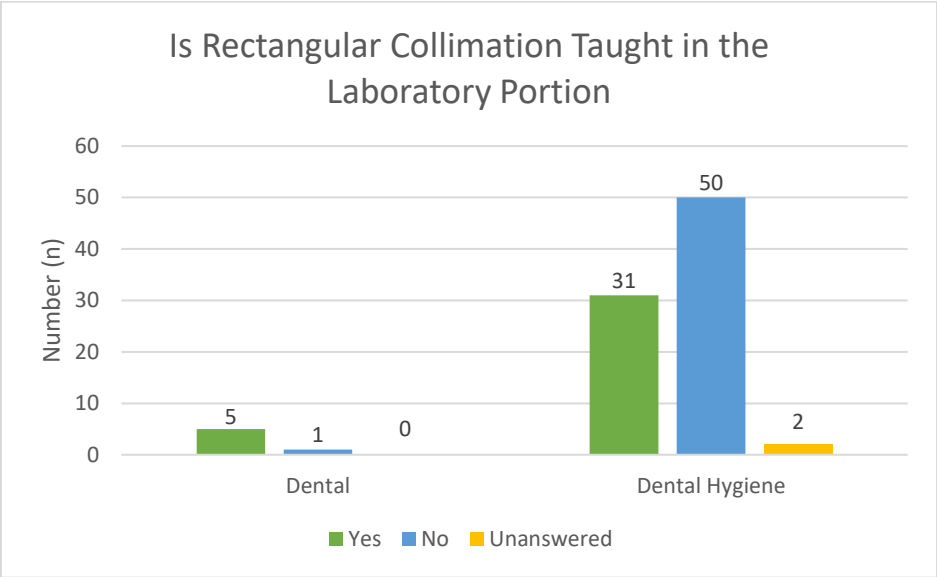


Figure 3. Rectangular collimation taught in laboratory portion

Question four asked if rectangular collimators were used when exposing radiographs during patient care. The number of dental programs that responded yes was 67% (n=4) and no was 33% (n=2). The number of dental hygiene programs that responded yes was 26% (n=22) and no was 71% (n=59). Submissions that did not answer this question were 3% (n=2) (Figure 4)

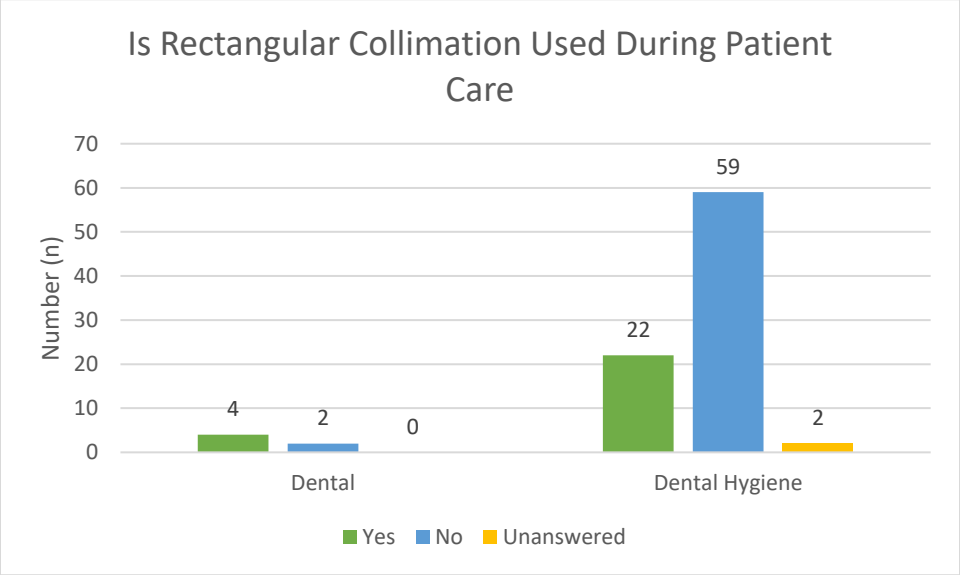


Figure 4. Rectangular collimation used during patient care

If the program answered that they do use rectangular collimation during patient care, they continued on to question five. This question queried if their program exclusively uses rectangular collimation devices with the exception of occlusal imaging. The number of dental programs that responded yes we only use rectangular collimation was 50% (n=2) and no we use both rectangular and round collimation was 50% (n=2). The number of dental hygiene programs that responded yes we only use rectangular collimation was 59% (n=13) and no we use both rectangular and round collimation was 41% (n=9). (Figure 5)

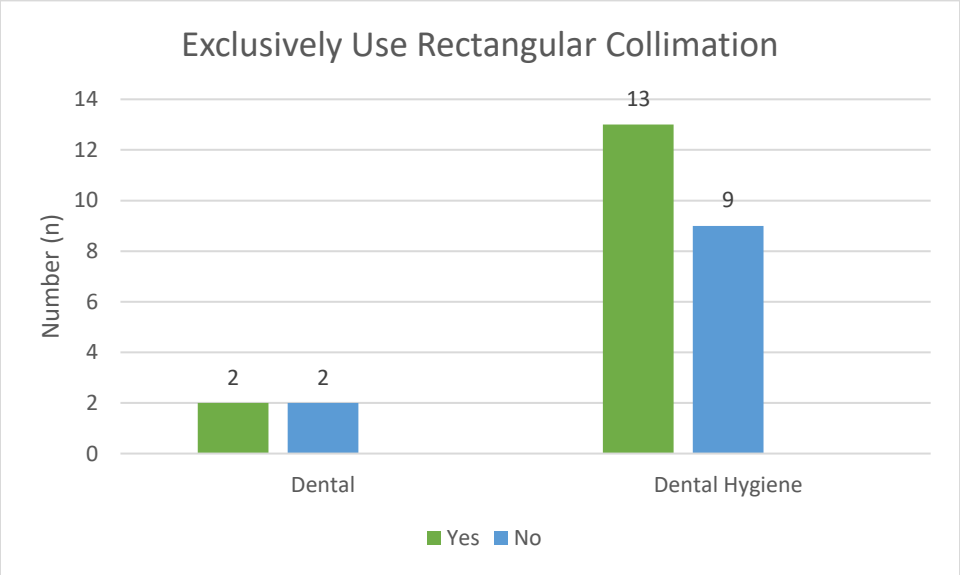


Figure 5. Is a rectangular collimation device exclusively used during patient care

Question six asked the programs to choose which type of rectangular collimation device their program uses. Fifty percent (n=2) of the dental programs and 45% (n=10) of the dental hygiene programs reported using a rectangular BID. A removable rectangular collimator was used in 25% (n=1) of the dental programs and 32% (n=7) of the dental hygiene programs. No dental programs reported using a rectangular lead XCP while 9% (n=2) of dental hygiene programs use them. Neither program stated that they use a laser aligning system with the BID and image receptor holder attached. Twenty-five percent (n=1) of the dental programs and 14% (n=3) of the dental hygiene programs use a rectangular collimation device that was not listed. (Figure 6)

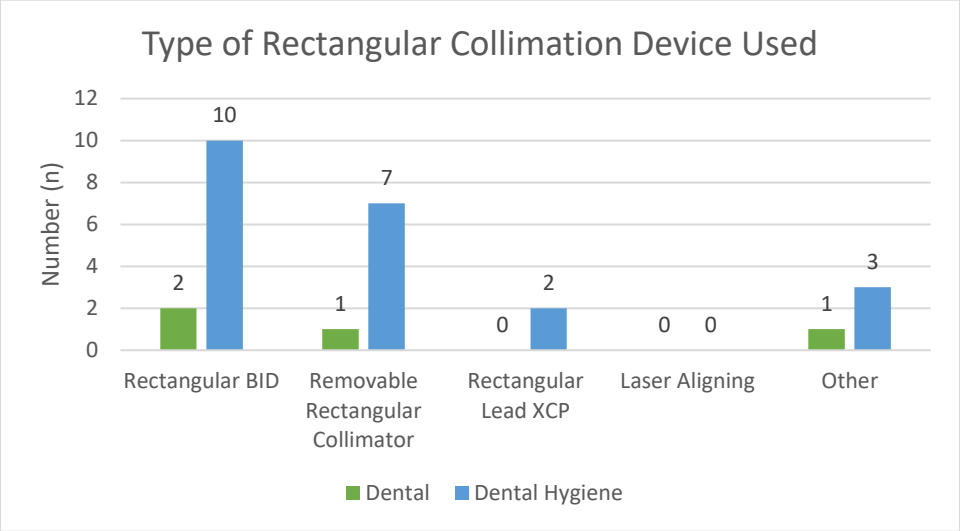


Figure 6. Type of rectangular collimation device used

Question seven inquired how many years their program has been utilizing rectangular collimation devices. The number of dental programs that answered 1-3 years was 0% (n=0) while dental hygiene programs was 32% (n=7). No dental programs and 9% (n=2) of the dental hygiene programs reported that they have used rectangular collimation devices for 4-6 years. Twenty-five percent (n=1) of dental programs and 9% (n=2) of dental hygiene programs answered 7-9 years. The majority of the dental programs at 75% (n=3) as well as the majority of dental hygiene programs at 46% (n=10) reported they have used rectangular collimation for more than 10 years. Submissions that did not answer this question were 4% (n=1) (Figure 7)

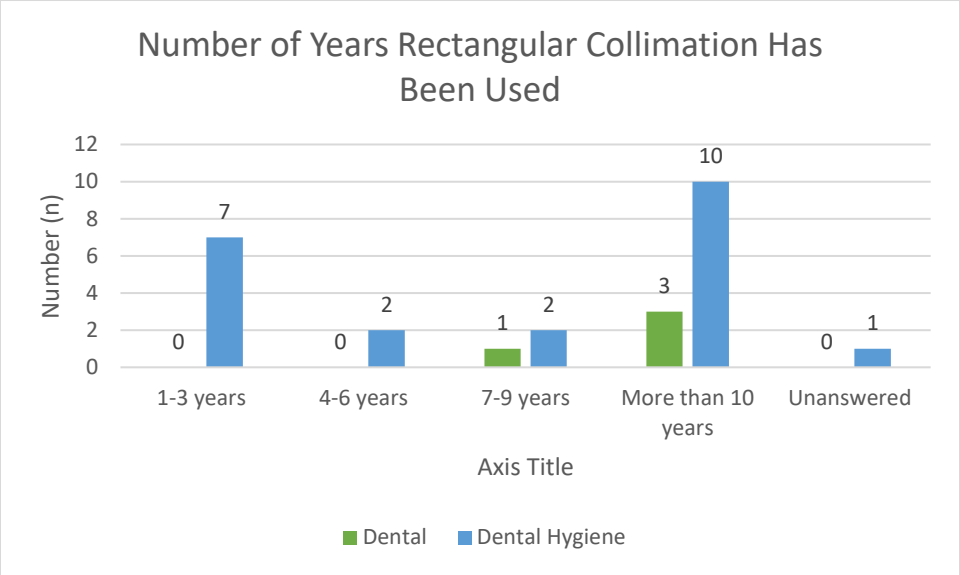


Figure 7. Number of years rectangular collimation has been used in each program

If the program answered no to question four, are rectangular collimation devices utilized when exposing radiographs during patient care, they were directed to skip to question eight. This asked for the reason rectangular collimation devices are not used in their program.

Of the two dental schools that do not use rectangular collimation, 100% (n=2) answered other. For the dental hygiene programs, 8% (n=5) reported they are concerned rectangular collimation devices may be difficult to use. The majority at 53% (n=31) are concerned there may be an increase in cone cuts resulting in retakes. Five percent (n=3) reported cost as the reason they do not use rectangular collimation. Twenty-two percent (n=13) chose other while 7% (n=4) did not answer this question. (Figure 8)

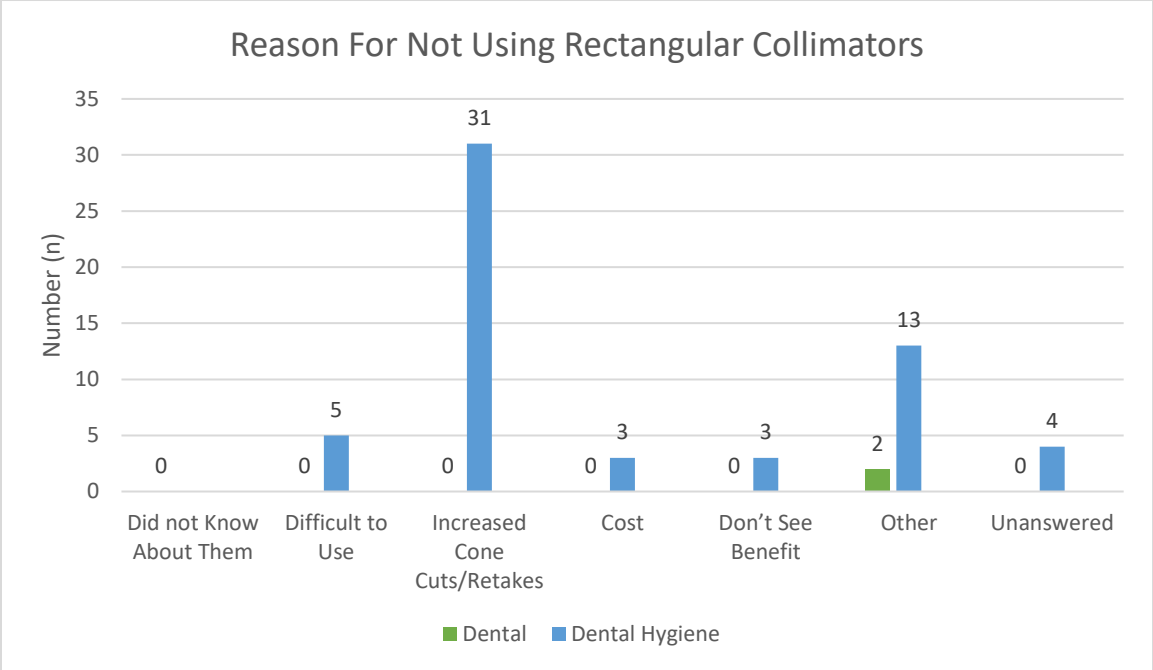


Figure 8. Reason for not using rectangular collimation

Further analysis was attempted using Fisher's Exact tests to cross compare survey responses from dental programs and dental hygiene programs for the two main questions; 1) Is rectangular collimation taught in the didactic portion of the radiology course and 2) Are rectangular collimation devices used when exposing radiographs during patient care. However, testing for significance between the two cohorts was problematic due to the small sample size of dental program responses compared to the larger sample size of the dental hygiene program responses.

	Dental Program (N=6)		Dental Hygiene Program (N=81)		Fisher's Exact p-value
Does your program discuss rectangular collimation in the didactic portion of the radiology course?	Yes 100% (n=6)	No 0% (n=0)	Yes 99% (n=80)	No 1% (n=1)	1.00
Do students in your program use a rectangular collimation device when exposing radiographs during patient care?	Yes 67% (n=4)	No 33% (n=2)	Yes 27% (n=22)	No 73% (n=59)	0.06

Table 1. Summary of findings

While the previous graphs presented the date for the individual program responses, the following tables represent the combined data obtained between the two cohorts for each question.

Table 2 shows the total of the responses to question two, does your program teach rectangular collimation in the didactic portion of the radiology course? The total number of respondents that answered yes was 96% while only 3% answered that they do not teach rectangular collimation in the didactic portion.

	Is Rectangular Collimation Taught in the Didactic Portion? N=89
Yes	96% (n=86)
No	3% (n=1)
Unanswered	1% (n=2)

Table 2. Is rectangular collimation taught in the didactic portion

Table 3 presents the total of the responses to question three, does your program teach rectangular collimation in the laboratory portion of the radiology course? The total number of respondents that answered yes was 40% while the majority, 57% said that they do not teach rectangular collimation in the laboratory portion.

	Is Rectangular Collimation Taught in the Laboratory Portion? N=89
Yes	40% (n=36)
No	57% (n=51)
Unanswered	3% (n=2)

Table 3. Is rectangular collimation taught in the laboratory portion

Table 4 presents the total of the responses to question four, do students in your program use rectangular collimation devices when exposing radiographs during patient care? The total number of respondents that answered yes was 29% while the majority at 69% answered that they do not use rectangular collimation devices during patient care.

	Are Rectangular Collimation Devices Used While Exposing Radiographs During Patient Care? N=89
Yes	29% (n=26)
No	69% (n=61)
Unanswered	2% (n=2)

Table 4. Are rectangular collimation devices used during patient care

Table 5 presents the total of the response to question five. With the exception of occlusal imaging, does your program exclusively utilize rectangular collimation devices when exposing radiographs during patient care? The majority, 60% stated that they exclusively utilize rectangular collimation devices while 40% answered that they use both rectangular and circular collimation devices.

	Are Rectangular Collimation Devices Exclusively Used When Exposing Radiographs During Patient Care? N=26
Yes	58% (n=15)
No	42% (n=11)

Table 5. Does your program exclusively using rectangular collimation

Table 6 presents the total of the responses to question six. Which option best describes the rectangular collimation device that your program uses? The majority, 46%, uses a rectangular BID.

	Which Best Describes the Rectangular Collimation Device Used? N=26
Rectangular BID	46% (n=12)
Removable rectangular collimator	30% (n=8)
Rectangular lead XCP	9% (n=2)
Laser aligning	0% (n=0)
Another type	15% (n=4)

Table 6. Type of rectangular collimation devices used

Table 7 presents the total of the responses to question seven. How long has your program been utilizing rectangular collimation devices. The majority at 50% stated that they have been using rectangular collimation devices for more than 10 years

	How Long Have Rectangular Collimation Devices Been Used? N=26
1-3 Years	27% (n=7)
4-6 Years	8% (n=2)
7-9 Years	12% (n=3)
More than 10 Years	50% (n=13)
Unanswered	3% (n=1)

Table 7. Years using rectangular collimation

Table 8 presents the total of the responses to question eight. What is the primary reason your program does not utilize a rectangular collimation device? The majority of the respondents at 51% answered that concern for cone cuts resulting in retakes was their reason for not using a rectangular collimation device.

	Main Reason Rectangular Collimation Devices Are Not Used N=61
Unaware of rectangular collimation devices	0% (n=0)
Difficult to use	8% (n=5)
Cone cuts/retakes	51% (n=31)
Cost	5% (n=3)
Do not see benefit	5% (n=3)
Other	25% (n=15)
Unanswered	6% (n=4)

Table 8. Reasons for not using rectangular collimation devices

Discussion

This study revealed that roughly all of the dental and dental hygiene programs that responded to this survey, provide education about rectangular collimation during the didactic portion of the radiology course. The majority of the programs however, responded that they do not teach rectangular collimation in the laboratory portion of the radiology course. Therefore, rectangular collimation devices are not being used while taking radiographs during patient care in the majority of clinical settings assessed.

Concern that there would be an increase in cone cuts, which would result in having to retake images, was the most common reason for not using a rectangular collimation device during patient care. While this is a valid concern, previous studies have indicated that there is not an increase in retakes when using a rectangular collimation device in conjunction with an XCP.[10] While cone cuts may be present on the images more frequently than when round collimation is used, the image quality remains diagnostic. Using rectangular collimation with digital radiography greatly reduces the radiation dose to the patient, therefore, concern for retakes should not be a reason rectangular collimation isn't being used.

Of the 29% that answered they do use a rectangular collimation device during patient care, a rectangular BID was the most common type. It was also determined that 50% of the programs that utilize a rectangular collimation device have been using them for more than 10 years.

The previously mentioned study by Geist, conducted in 2001, determined that 47% of dental programs were using rectangular collimation while 52% were using round. Although the sample size for this study was notably smaller, the results show that more dental programs (67%)

are using rectangular collimation devices now than they were in 2001. However, a larger response rate from the dental programs would help determine if this is an accurate trend.

Learning radiographic technique with rectangular collimation while in school may encourage providers to continue their use in practice after graduation.[13] The previous studies referenced were all conducted using licensed dental providers as the subjects. For this reason, future studies on the incorporation of rectangular collimation devices into the student setting would be beneficial. Also, continuing education courses about the benefits of rectangular collimation, along with hands on practice using the devices, would provide an opportunity for dental providers to incorporate them into their care. Additional studies to evaluate if image quality is improved when using rectangular collimation devices may persuade providers to implement them in their clinics, depending on the results.

Limitations

The major limitation of the study was the low response rate. This is particularly true for the dental school participants, which limited the ability to compare dental programs with dental hygiene programs. The format of the survey may have limited the results. In total, 16 uncompleted surveys were submitted. If the survey was designed to only be able to advance to the next question upon completion of the current question, the number of completed surveys may have been larger.

Question eight could have provided valuable information if it was open ended. An email was received from one of the survey respondents stating the reason their program does not use rectangular collimation devices is simply because they do not have them. More data could have been obtained if survey question eight, what is the reason your program does not use a rectangular collimation device, allowed the respondents to answer freely.

Conclusion

The use of rectangular collimators has proven to reduce the radiation dose the patient receives as well as improve image quality for the dental provider.[1] For these reasons, rectangular collimation should be taught in the didactic and laboratory portion of every dental and dental hygiene program. However, this survey revealed that while the majority of dental and dental hygiene programs are educating their students about rectangular collimation in the didactic portion of the radiology course, this education is not being continued into the clinical or laboratory setting. Only 29% of the programs surveyed responded that they are using a rectangular collimation device during patient care. Learning radiographic techniques in the clinical or laboratory setting will likely encourage providers to continue using rectangular collimation devices after graduation.[13] Further research on the barriers of implementing rectangular collimation in the educational setting should be conducted.

Chapter 5: Article for Submission

Journal of Dental Hygiene

Title Page

Utilization of Rectangular Collimators in Dental and Dental Hygiene Programs

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Keywords: Radiographs, Collimation, Rectangular Collimation

ABSTRACT

Purpose: The purpose of this study was to determine what extent, if any, rectangular collimation devices are being utilized in dental and dental hygiene programs

Methods: A survey was created using the online survey tool Redcap. The survey contained 5-7 questions inquiring about rectangular collimation in the didactic, laboratory and patient care setting in dental and dental hygiene programs. Descriptive statistics were used to analyze each question.

Results: A total of 97 programs responded to the survey, however 16 of those surveys were not completed. To be included in the data analysis, question number one (do you represent a dental or dental hygiene program) must have been answered. Eighty-nine (N=89) responses qualified. Of those, 6 were dental programs and 83 were dental hygiene programs. In total, 96% (n=86) teach rectangular collimation in the didactic portion of the radiology course while only 29% (n=26) use a rectangular collimation device while providing patient care.

Conclusion: The use of rectangular collimators has proven to reduce the radiation dose the patient receives as well as improve image quality for the dental provider. However, this study revealed that while the majority of dental and dental hygiene programs are educating their students about rectangular collimation in the didactic portion of the radiology course, this education is not being continued into the clinical or laboratory setting. Learning radiographic techniques in the clinical or laboratory setting will likely encourage providers to continue using rectangular collimation devices after graduation. Further research on the barriers of implementing rectangular collimation in the educational setting should be conducted.

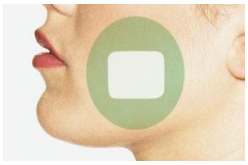
INTRODUCTION

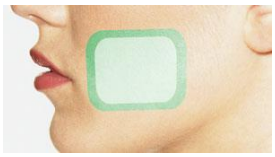
Dental radiographs play an essential role in the diagnosis of oral disease and are necessary to provide comprehensive treatment for each patient. The safety of dental radiographs and x-radiation exposure can be a concern for dental patients. As such, patient safety and quality diagnostic images should be a goal of every dental provider. One way to achieve both of these goals is with the use of collimation. Collimation restricts the size and shape of the x-ray beam. Restricting the size and shape of the x-ray beam results in reduced patient exposure to x-radiation and increased image quality.

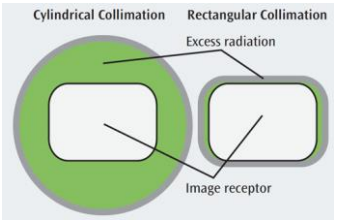
Dental x-ray units consist of several parts. There is the control panel, arm, yoke, tube head and positioning indicating device (PID). Inside the PID there is a lead collimator. The collimator is used to restrict and reduce the size of the x-ray beam. The majority of PID's are circular in shape while the image receptor is rectangular. This means that the area of the x-ray beam is much larger than the area of the receptor, which results in the beam interacting with the surrounding tissues. Interaction with any object creates scatter radiation, therefore the larger the amount of tissue being irradiated; the more scatter is created. Scatter in turn degrades the quality of the image. Reducing excessive scatter radiation by narrowing the beam increases image contrast and reduces noise/fog (gray film). [1]

In dentistry the most common size intraoral image receptor is rectangular in shape with dimensions of 41mm x 31mm. The average diameter of a round collimator is 7cm, which creates an exposure area three times the size of the image receptor. Some newer machines are equipped with a 6cm circle that still creates an area twice the size of the receptor. When patients are exposed with a round collimated beam instead of a rectangular beam, they are exposed to at least 2 times more radiation than is needed.

The diagram below demonstrates the difference in the size of the radiated area when using a round collimator versus a rectangular collimator.







Source: https://dimensionsofdentalhygiene.com/article/reduce-radiation-with-rectangular-collimation/

The dental professional has the responsibility to protect their patients and adhere to the concept of ALARA. This stands for As Low As Reasonably Achievable. ALARA was created in 1974 and enforced on a federal level by the Nuclear Regulatory Commission.[16] To comply with ALARA, there are several tools the dental professional can use. These include appropriate receptor selection, correct exposure technique, proper use of shielding and collimation.

Rectangular collimation restricts the size of the x-ray beam. Utilizing a rectangular collimation device exposes 70% less tissue volume than round collimation, which causes a decrease in the effective dose to the patient roughly fivefold. Additionally, rectangular collimation reduces scatter radiation, which improves image quality. Devices that provide rectangular collimation include rectangular collimators that attach to round PIDs, metal rings that clip into the instrument beam guide, or facial shield collimators that are incorporated into receptor-holding instruments.[18]

The following images are some examples of kits that can easily be attached to a conventional round PID:

Source: https://www.dentalcompare.com/Dental-Digital-Imaging-Dental-Imaging/5072-Rectangular-Collimator/

While there are easy solutions to convert from circular collimation to rectangular collimation, providers are hesitant to make the change. One of the main concerns with using rectangular collimation is the risk of missing anatomy due to the restricted beam, which may require retaking images.[5] According to Castellanos 2013, cutoff errors may occur more frequently when a rectangular collimator is being used, however these errors were often a result of poor technique. Furthermore, these radiographs were diagnostic and retakes were not required. Harrison, 2013, also found that while errors do occur more often with the use of rectangular collimators, they do not result in a loss of diagnostic information and therefore do not need to be retaken.

Retake rates for dental and dental hygiene students using rectangular collimation were assessed is another qualifying study. The results showed an 11% re-exposure rate for dental students and a 6% re-exposure rate for dental hygiene students. However the majority of the retakes were due to improper placement of the image receptor and not the placement of the rectangular collimation device. These low retake rates show that implementing rectangular collimation devices in the educational setting is feasible.[9,14]

However, Shetty et al. reference a study from 2001 stating that 65 dental schools across North America responded to a survey querying about the use of rectangular collimation devices

in their programs. The results of that survey showed that only 47% stated they were using rectangular collimation while 52% used round collimation. [3]

The National Council of Radiation Protection (NCRP) published a report in December 2003 (NCRP Report # 145) and states in part: Rectangular collimation of the beam shall be used for periapical and interproximal bitewing radiography.[11] Undoubtedly rectangular collimation has been around for several decades; however, it is unknown how often rectangular collimation is taught and used in dental and dental hygiene programs.

The purpose of this research was to assess what extent rectangular collimation was being taught and used in the educational setting? The hypothesis is that rectangular collimators are not being used in the majority of dental and dental hygiene programs. The most likely reasons are lack of knowledge about rectangular collimation devices and fear that they may be difficult to use.

METHODS AND MATERIALS

For this study, a survey was sent to the directors of dental hygiene programs and dental programs accredited by the Commission on Dental Accreditation. The survey included multiple-choice questions pertaining to the use of rectangular collimation devices in their programs. The results of this survey evaluated what extent rectangular collimators are being used in the educational setting. It also sought to answer the question of why they are not being used, if that was the case.

The sample population for this study included 340 accredited dental hygiene and dental programs in the United States. The survey was sent to the director of each program via email and

they were asked to pass the survey along to the Radiology course and lab coordinator. The contact information was obtained from the American Dental Hygienist Association (ADHA) and the American Dental Association (ADA) websites. Programs not listed on these websites were not included in this study.

This was a descriptive study, using an online survey to obtain quantitative data about rectangular collimator usage. The survey was created using the online software service called Red Cap. Upon approval from the university's Human Research Protection Office (HRPO) (Study ID 18-683), the surveys were sent via email to the previously mentioned dental hygiene programs and dental programs.

The questions on the survey were multiple choice. Some multiple-choice questions had further branch questions dependent on a yes or no response. The survey questions aimed to determine if rectangular collimation devices are being used in the educational setting. What type/brand of collimators are the programs using? How long has their program been using rectangular collimation devices? If rectangular collimation devices are not being used, what are the barriers or concerns preventing their use?

The survey was available to the Radiology course and lab coordinators for two weeks. At the end of the two-week time period, the survey was closed and the data was compiled and analyzed. A population test was done to determine the rate of responses from both the dental and dental hygiene programs. Fisher's Exact tests were used to analyze survey responses between the two cohorts ($P = .05$).

RESULTS

A total of 97 surveys were received. To be included in the data analysis, question number one, asking the respondents to identify which type of program they represented (dental or dental hygiene) must have been answered. A total of 8 programs did not answer this question. Therefore, the overall response rate used was 26% (N=89) while the individual response rate from dental programs was 7% (n=6) and dental hygiene programs was 93% (n=83). (Figure 1)

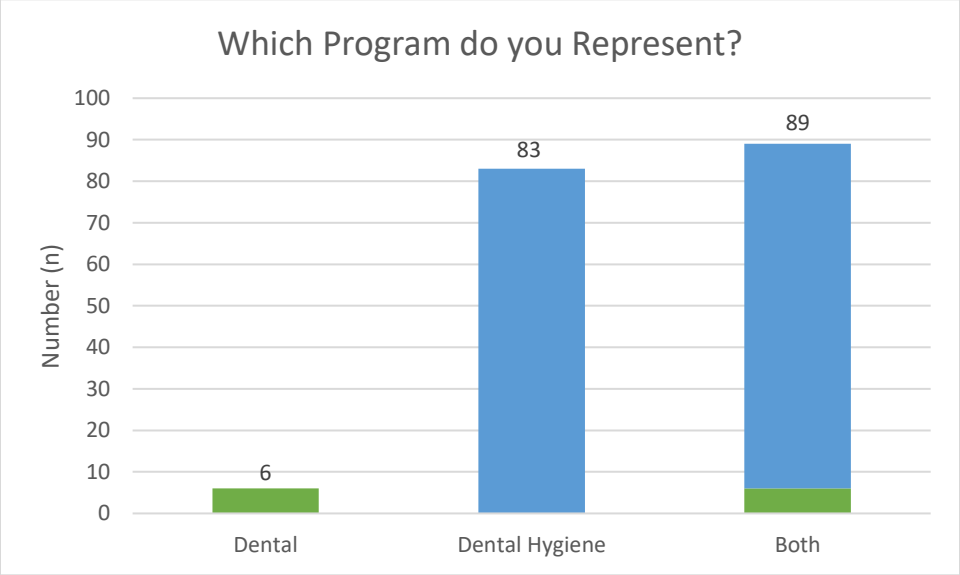


Figure 9. Type of program represented (dental or dental hygiene)

Question two asked; does your program teach rectangular collimation in the didactic portion of the radiology course? The total number of respondents that answered yes was 96% while only 3% answered that they do not teach rectangular collimation in the didactic portion.

	Is Rectangular Collimation Taught in the Didactic Portion? N=89
Yes	96% (n=86)
No	3% (n=1)
Unanswered	1% (n=2)

Table 9. Is rectangular collimation taught in the didactic portion

Individually, the number of dental programs that responded yes was 100% (n=6). The number of dental hygiene programs that responded yes was 96% (n=80) and no was 1% (n=1). (Figure 2)

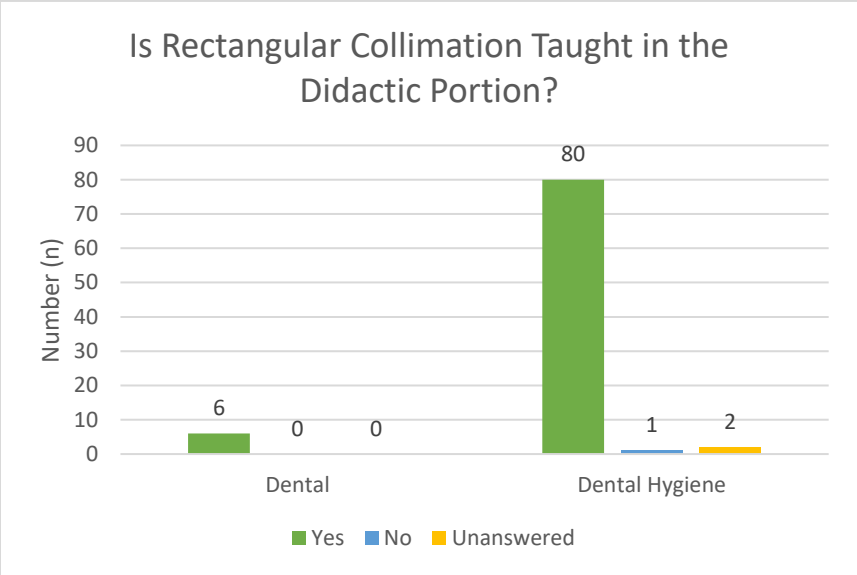


Figure 10. Rectangular collimation taught in didactic portion

Table 3 presents the total of the responses to question three, does your program teach rectangular collimation in the laboratory portion of the radiology course? The total number of respondents that answered yes was 40% while the majority, 57% said that they do not teach rectangular collimation in the laboratory portion.

	Is Rectangular Collimation Taught in the Laboratory Portion? N=89
Yes	40% (n=36)
No	57% (n=51)
Unanswered	3% (n=2)

Table 10. Is rectangular collimation taught in the laboratory portion

Individually, the number of dental programs that responded yes was 83% (n=5) and no was 17% (n=1). The number of dental hygiene programs that responded yes was 37% (n=31) and no was 60% (n=50). (Figure 3)

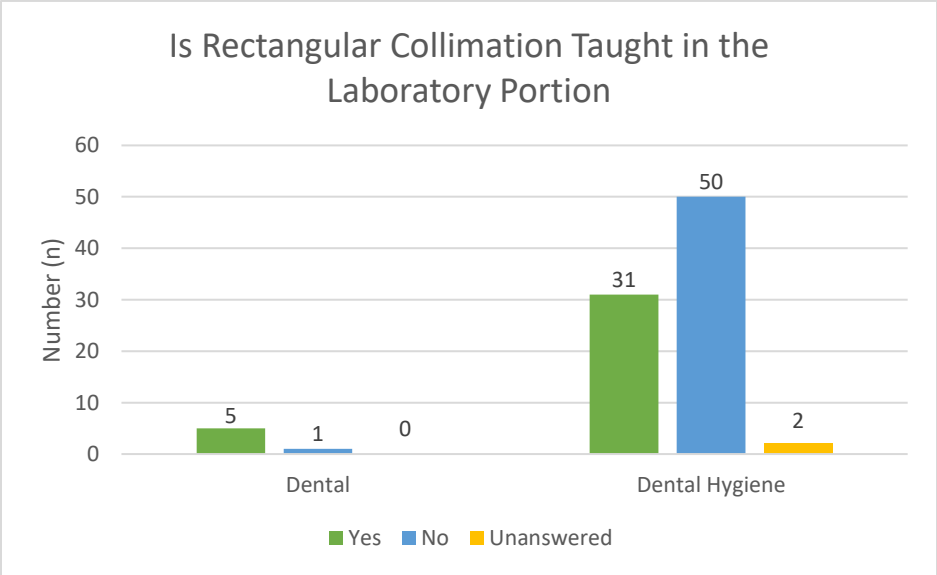


Figure 11. Rectangular collimation taught in laboratory portion

Table 4 presents the total of the responses to question four, do students in your program use rectangular collimation devices when exposing radiographs during patient care? The total number of respondents that answered yes was 29% while the majority at 69% answered that they do not use rectangular collimation devices during patient care.

	Are Rectangular Collimation Devices Used While Exposing Radiographs During Patient Care? N=89
Yes	29% (n=26)
No	69% (n=61)
Unanswered	2% (n=2)

Table 11. Are rectangular collimation devices used during patient care

Individually, dental programs that responded yes was 67% (n=4) and no was 33% (n=2). The number of dental hygiene programs that responded yes was 26% (n=22) and no was 71% (n=59). (Figure 4)

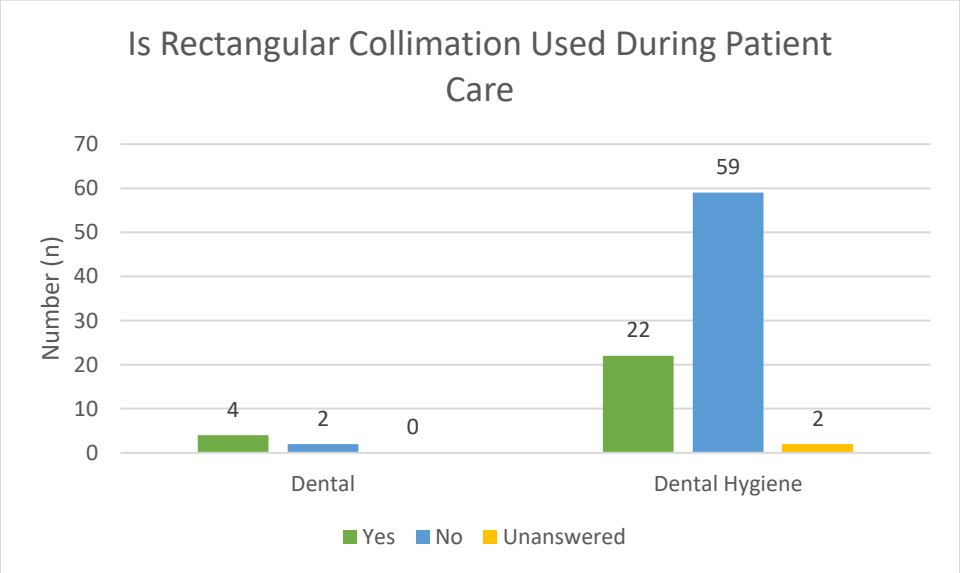


Figure 12. Rectangular collimation used during patient care

Table 5 presents the total of the response to question five. With the exception of occlusal imaging, does your program exclusively utilize rectangular collimation devices when exposing radiographs during patient care? The majority, 60% stated that they exclusively utilize rectangular collimation devices while 40% answered that they use both.

	Are Rectangular Collimation Devices Exclusively Used When Exposing Radiographs During Patient Care? N=26
Yes	58% (n=15)
No	42% (n=11)

Table 12. Does your program exclusively using rectangular collimation

The number of dental programs that responded yes we only use rectangular collimation was 50% (n=2) and no we use both rectangular and round collimation was 50% (n=2). The number of dental hygiene programs that responded yes we only use rectangular collimation was 59% (n=13) and no we use both rectangular and round collimation was 41% (n=9). (Figure 5)

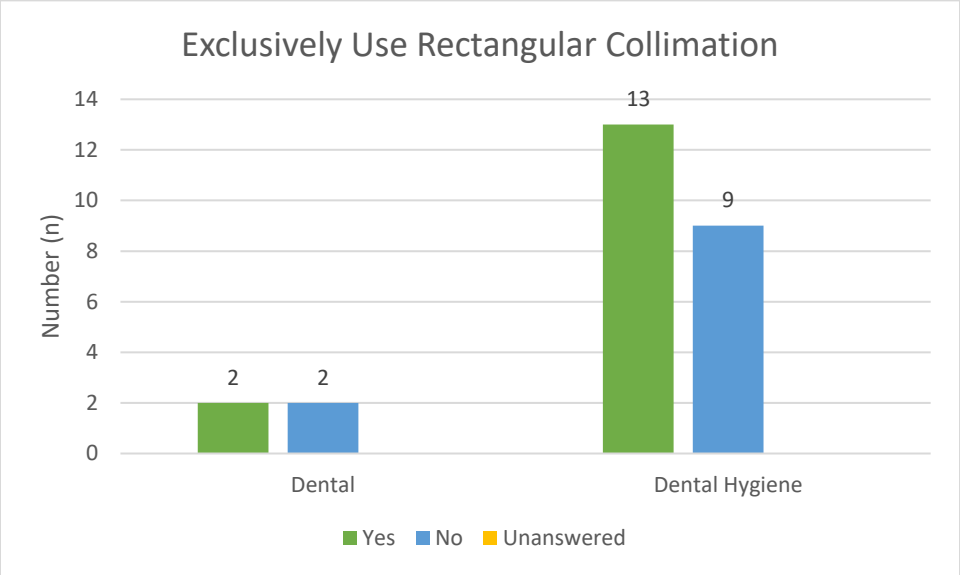


Figure 13. Is a rectangular collimation device exclusively used during patient care

Table 6 presents the total of the responses to question six. Which option best describes the rectangular collimation device that your program uses? The majority, 46%, uses a rectangular BID.

	Which Best Describes the Rectangular Collimation Device Used?

	N=26
Rectangular BID	46% (n=12)
Removable rectangular collimator	30% (n=8)
Rectangular lead XCP	9% (n=2)
Laser aligning	0% (n=0)
Another type	15% (n=4)

Table 13. Type of rectangular collimation devices used

Individually, the majority of dental at 50% (n=2) and dental hygiene programs at 45% (n=10) use a rectangular BID. (Figure 6)

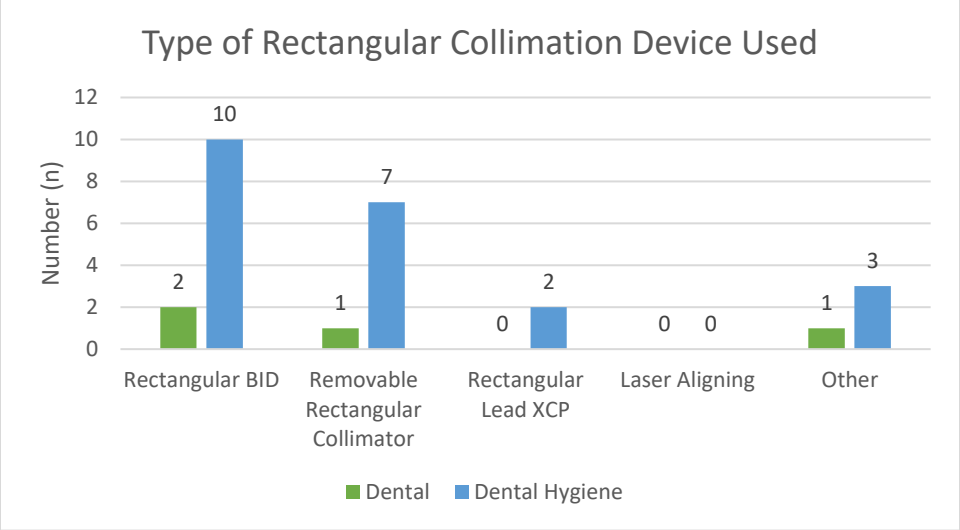


Figure 14. Type of rectangular collimation device used

Table 7 presents the total of the responses to question seven. How long has your program been utilizing rectangular collimation devices. The majority at 50% stated that they have been using rectangular collimation devices for more than 10 years

	How Long Have Rectangular Collimation Devices Been Used?

	N=26
1-3 Years	27% (n=7)
4-6 Years	8% (n=2)
7-9 Years	12% (n=3)
More than 10 Years	50% (n=13)
Unanswered	3% (n=1)

Table 14. Years using rectangular collimation

Individually, the majority of the dental programs at 75% (n=3) as well as the majority of dental hygiene programs at 46% (n=10) reported they have used rectangular collimation for more than 10 years. (Figure 7)

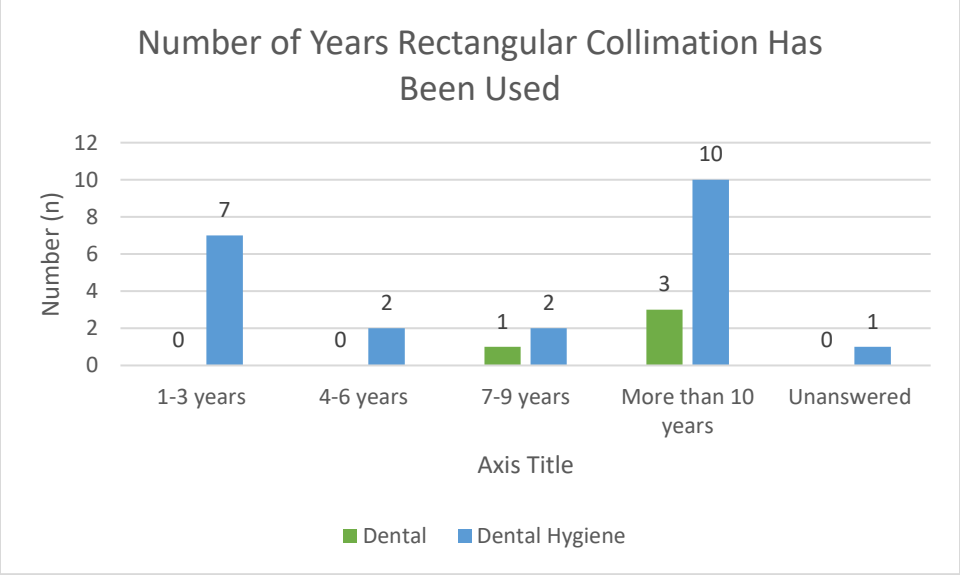


Figure 15. Number of years rectangular collimation has been used in each program

Table 8 presents the total of the responses to question eight. What is the primary reason your program does not utilize a rectangular collimation device? The majority of the respondents at 51% answered that concern for cone cuts resulting in retakes was their reason for not using a rectangular collimation device.

	Main Reason Rectangular Collimation Devices Are Not Used? N=61
Unaware of rectangular collimation devices	0% (n=0)
Difficult to use	8% (n=5)
Cone cuts/retakes	51% (n=31)
Cost	5% (n=3)
Do not see benefit	5% (n=3)
Other	25% (n=15)
Unanswered	6% (n=4)

Table 15. Reasons for not using rectangular collimation devices

Individually, the two dental schools that do not use rectangular collimation, 100% (n=2) answered other. The majority of dental hygiene programs at 53% (n=31) are concerned there may be an increase in cone cuts resulting in retakes. (Figure 8)

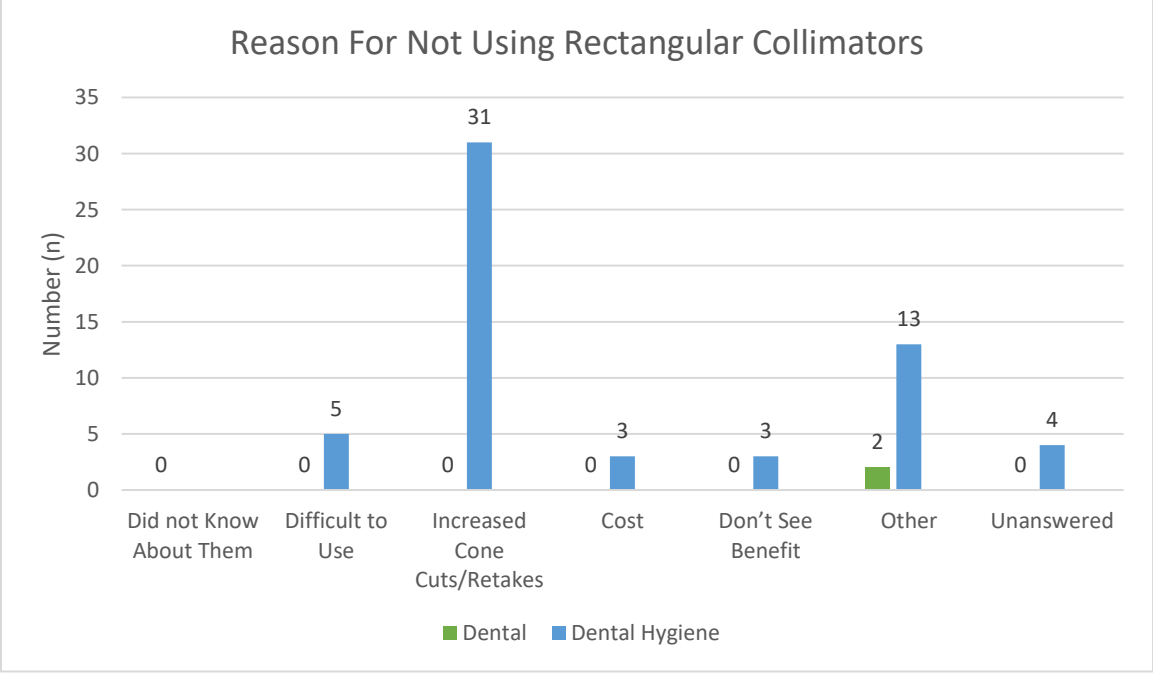


Figure 16. Reason for not using rectangular collimation

Further analysis was attempted using Fisher's Exact tests to cross compare survey responses from dental programs and dental hygiene programs for the two main questions. However, testing for significance between the two cohorts was problematic due to the small sample size of dental program responses compared to the larger sample size of the dental hygiene program responses. (Table 9)

	Dental Program (N=6)		Dental Hygiene Program (N=81)		Fisher's Exact p-value
Does your program discuss rectangular collimation in the didactic portion of the radiology course?	Yes 100% (n=6)	No 0% (n=0)	Yes 99% (n=80)	No 1% (n=1)	1.00
Do students in your program use a rectangular collimation device when exposing radiographs during patient care?	Yes 67% (n=4)	No 33% (n=2)	Yes 27% (n=22)	No 73% (n=59)	0.06

Table 9. Summary of findings

DISCUSSION

This study revealed that roughly all of the dental and dental hygiene programs that responded to this survey, provide education about rectangular collimation during the didactic portion of the radiology course. The majority of the programs however, responded that they do not teach rectangular collimation in the laboratory portion of the radiology course. Therefore, rectangular collimation devices are not being used while taking radiographs during patient care in the majority of clinical settings assessed.

Concern that there would be an increase in cone cuts, which would result in having to retake images, was the most common reason for not using a rectangular collimation device

during patient care. While this is a valid concern, previous studies have indicated that there is not an increase in retakes when using a rectangular collimation device in conjunction with an XCP.[10] While cone cuts may be present on the images more frequently than when round collimation is used, the image quality remains diagnostic. Using rectangular collimation with digital radiography greatly reduces the radiation dose to the patient, therefore, concern for retakes should not be a reason rectangular collimation isn't being used.

Of the 29% that answered they do use a rectangular collimation device during patient care, a rectangular BID was the most common type. It was also determined that 50% of the programs that utilize a rectangular collimation device have been using them for more than 10 years.

The previously mentioned study by Geist, conducted in 2001, determined that 47% of dental programs were using rectangular collimation while 52% were using round. Although the sample size for this study was notably smaller, the results show that more dental programs (67%) are using rectangular collimation devices now than they were in 2001. However, a larger response rate from the dental programs would help determine if this is an accurate trend.

Learning radiographic technique with rectangular collimation while in school may encourage providers to continue their use in practice after graduation.[13] The previous studies referenced were all conducted using licensed dental providers as the subjects. For this reason, future studies on the incorporation of rectangular collimation devices into the student setting would be beneficial. Also, continuing education courses about the benefits of rectangular collimation, along with hands on practice using the devices, would provide an opportunity for dental providers to incorporate them into their care. Additional studies to evaluate if image

quality is improved when using rectangular collimation devices may persuade providers to implement them in their clinics, depending on the results.

CONCLUSION

The use of rectangular collimators has proven to reduce the radiation dose the patient receives as well as improve image quality for the dental provider.[1] For these reasons, rectangular collimation should be taught in the didactic and laboratory portion of every dental and dental hygiene program. However, this survey revealed that while the majority of dental and dental hygiene programs are educating their students about rectangular collimation in the didactic portion of the radiology course, this education is not being continued into the clinical or laboratory setting. Only 29% of the programs surveyed responded that they are using a rectangular collimation device during patient care. Learning radiographic techniques in the clinical or laboratory setting will likely encourage providers to continue using rectangular collimation devices after graduation.[13] Further research on the barriers of implementing rectangular collimation in the educational setting should be conducted.

Appendix A:

HRPP Approval Letter

Human Research Protections Program

October 16, 2018

Lindsey Lee
lindseylee@salud.unm.edu

Dear Lindsey Lee:

On 10/15/2018, the HRRC reviewed the following submission:

Type of Review:	Initial Study
Title of Study:	Utilization of Rectangular Collimation in Dental and Dental Hygiene Programs
Investigator:	Lindsey Lee
Study ID:	18-683
Submission ID:	18-683
IND, IDE, or HDE:	None
Submission Summary:	Initial Study
Documents Approved:	• Rectangular Collimation Introduction to Survey Email • Rectangular Collimation Protocol • Rectangular Collimation Consent • Rectangular Collimation Survey
Review Category:	EXEMPTION: Categories (2) Tests, surveys, interviews, or observation
Determinations/Waivers:	Provisions for Consent are adequate. HIPAA Authorization Addendum Not Applicable.
Submission Approval Date:	10/15/2018
Approval End Date:	None
Effective Date:	**10**/15/**2018**

The HRRC approved the study from 10/15/2018 to inclusive. If modifications were required to secure approval, the effective date will be later than the approval date. The "Effective Date" 10/15/2018 is the date the HRRC approved your modifications and, in all cases, represents the date study activities may begin.

Because it has been granted exemption, this research is not subject to continuing review.

Please use the consent documents that were approved by the HRRC. The approved consents are available for your retrieval in the "Documents" tab of the parent study.

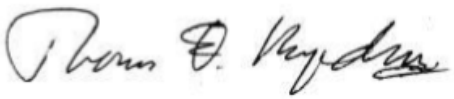
This determination applies only to the activities described in this submission and does not apply should you make any changes to these documents. If changes are being considered these must be

submitted for review in a study modification to the HRRC for a determination prior to implementation. If there are questions about whether HRRC review is needed, contact the HRPO before implementing changes without approval. A change in the research may disqualify this research from the current review category. You can create a modification by clicking Create Modification / CR within the study.

If your submission indicates you will translate materials post-approval of English materials, you may not recruit or enroll participants in another language, until all translated materials are reviewed and approved.

In conducting this study, you are required to follow the Investigator Manual dated April 1, 2015 (HRP-103), which can be found by navigating to the IRB Library.

Sincerely,



Thomas F. Byrd, MD
HRRC Chair

Appendix B:

Informed Consent

University of New Mexico Health Sciences Center
Informed Consent Cover Letter for Anonymous Surveys
STUDY TITLE

Utilization of Rectangular Collimation in Dental and Dental Hygiene Programs

Lindsey Lee RDH, MS from the Department of Dental Hygiene, is conducting a research study. The purpose of the study is to determine to what extent, if any, rectangular collimation is being utilized in dental and dental hygiene programs. You are being asked to participate in this study because your program includes a dental radiography course.

Your participation will involve completing a brief survey. The survey should take about 5 minutes to complete. Your involvement in the study is voluntary, and you may choose not to participate. There are no names or identifying information associated with this survey. The survey includes questions such as does your program discuss rectangular collimation in the didactic portion of the course, and does your program teach radiographic technique using a rectangular collimation device in the laboratory portion of the course. You can refuse to answer any of the questions at any time. There are no known risks in this study, but some individuals may experience discomfort when answering questions. All data will be kept for 2 years in a locked file in Lindsey Lee's office and then destroyed.

The findings from this project will provide information on the utilization of rectangular collimation in the educational setting. If published, results will be presented in summary form only.

If you have any questions about this research project, please feel free to call Lindsey Lee at (505) 272-0838. If you have questions regarding your legal rights as a research subject, you may call the UNMHSC Office of Human Research Protections in Albuquerque, New Mexico at (505) 272-1129.

By hitting submit upon completion of the survey, you will be agreeing to participate in the above described research study.

Thank you for your consideration.

Sincerely,

Lindsey Lee RDH, MS
LindseyLee@salud.unm.edu

505-272-0838

HRRC#:18-683

Version Date: 10/15/2018

Appendix C:

Recruitment Email

Hello Dental and Dental Hygiene Program Directors,

Graduate student, Liz Wagner RDH, BS, MS candidate from the Department of Dental Medicine at the University of New Mexico, is conducting a research study. The purpose of the study is to evaluate to what extent, if any, rectangular collimation devices are being utilized in dental and dental hygiene programs.

I am emailing you today to ask if you would please forward this email to your Radiology Course Coordinator. They can participate in this study by completing the attached survey. The survey should take approximately 5 minutes. Participation is voluntary, no response is required if your program should decline to take part in this study. Those participating will complete the online survey and hit submit upon completion

Thank you,
Liz Wagner, RDH, BS, MS candidate

Primary Investigator:
Lindsey Lee, RDH, MS, Assistant Professor, Dental Hygiene
505-272-0838
LindseyLee@Salud.unm.edu

Appendix D:

Survey

1. Please select which program you represent?
    a. Dental Program
    b. Dental Hygiene Program

2. Does your program discuss rectangular collimation in the didactic portion of the radiology course?
    a. Yes
    b. No

3. Does your program teach radiographic technique using a rectangular collimation device in the laboratory portion of the radiology course?
    a. Yes
    b. No

4. Do students in your program use a rectangular collimation device when exposing radiographs during patient care?
    a. Yes (answer questions 5, 6, 7)
    b. No (answer question 8)

5. With the exception of occlusal imaging, do students in your program exclusively use a rectangular collimation device when exposing radiographs during patient care?
    a. Yes, we only use rectangular collimation
    b. No, we use both rectangular and circular collimation

6. Which type of rectangular collimation device does your program currently use?
    a. Rectangular BID
    b. A removeable rectangular collimator
    c. A rectangular lead XCP used with a round BID
    d. A laser aligning collimator system with the BID and image receptor holder attached
    e. Another Type
7. How long has your program utilized a rectangular collimation device when exposing radiographs during patient care?
    a. 1-3 years
    b. 4-6 years
    c. 7-9 years
    d. More than 10 years

8. What is the primary reason your program does not use a rectangular collimation device?
    a. Did not know rectangular collimators were available
    b. Concern that rectangular collimators will be difficult to use
    c. Concern for increased occurrence of cone cuts, resulting in retakes
    d. Concern regarding the cost of rectangular collimator conversion
    e. Do not see the benefit of rectangular collimators
    f. Other

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