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Original Article

# Overview of dental radiation technologists in Taiwan



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**Abstract** *Background/purpose:* In Taiwan, there is no independent licensing system for dental radiation technologists. A licensed medical radiation technologist who engages in dental radiology is the so-called dental radiation technologist. This study explored mainly the profile of dental radiation technologists in Taiwan.

*Materials and methods:* This study used the methods of documentary analysis, dental radiation manpower survey, and the secondary data analysis to find the profile of dental radiation technologists in Taiwan.

*Results:* There were currently 59 dental radiology departments and 101 dental radiation technologists (29 males and 72 females) in 57 hospitals and their branches. Of the 101 dental radiation technologists, 56 worked in the medical centers, 28 in the regional hospitals, and 17 in the district hospitals. More than half of the dental radiation technologists were concentrated

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in the medical centers (55.45%, 56/101) or the northern region of Taiwan (57.43%, 58/101), especially in the northern medical centers (30.69%, 31/101).

*Conclusion:* In Taiwan, the manpower of dental radiation technologists is insufficient, and dental radiation technologists usually work in the dental departments of the hospitals. A large number of clinic dentists lack dental radiation technologists to assist in dental radiology works and the clinic dentists have to perform the dental radiology works by themselves. Therefore, a dental radiology education system should be established to design innovative dental radiology courses for radiological technology students. This in turn can provide a new practice direction for medical radiation technologists and expand their potential participation in the field of dental radiology.

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## Introduction

In late 1895, Wilhelm Conrad Röntgen discovered X-rays. In 1896, two weeks after Roentgen's discovery published, the German dentist Otto Walkhoff acquired an X-ray radiograph of his own teeth with the help of Fritz Giesel. This is the world's first X-ray radiograph of human teeth. The use of X-ray in medical photography has spread around the world since 1896. Then, the first dental X-ray machine was manufactured in Germany in 1905 by a company now known as Siemens. To date, dental radiology has been existed for over 120 years.<sup>1–4</sup>

In fact, the development of dental radiology in Taiwan is almost in step with the world. During the Japanese colonial period (1895–1945), the colonial government directly transplanted the western medical system to Taiwan, including the dental system.<sup>5</sup> According to Taiwan's dentist-related laws and regulations, as early as 1918 (Taisho 7), Enforcement Rules for Taiwan Dentist Order stipulated the professional names of specialties in dentistry. At that time, dental X-ray was already one of 11 dental specialties.<sup>4</sup>

A previous study concluded that Taiwan Government Taipei Hospital probably already had dental X-ray machines in the 1920s, and the dentists of Taipei Hospital also had the professional ability to operate dental X-ray machines and to use the dental radiography for diagnoses of jawbone diseases. In those days, in addition to dentists, their assistants or dental technicians might also assist or participate in the operation of dental X-ray machines, which could be regarded as the earliest form of dental radiation workers in Taiwan. Therefore, dental radiology in Taiwan also has a history of at least 100 years and is almost synchronized with the world.<sup>4–9</sup>

With the development of high specialization and division in medicine, both physicians and dentists need personnel in the role of medial radiation technologists to assist them in the operation of X-ray equipment. However, in terms of dental radiation, the medical radiation technologists who engage in dental radiation work are so-called dental radiation technologists. In the field of dentistry or medical radiation, in fact, there are no such personnel as dental assistant-certified radiation technologist or dental radiog-

raphers in Taiwan's dental system. In addition, there is no relevant system for training dental radiation technologists in the education of radiological technology, and there are few courses of dental radiology in the schools of radiological technology. The way to become a dental radiation technologist is usually through the completion of the following processes. The graduates of schools of radiological technology get a medical radiation technologist license through examination. Then, they enter the dental radiology department of a hospital, receive some dental radiation training, and engage in dental radiation work.

Currently, there is no study about dental radiation technologists in Taiwan. This study used the methods of documentary analysis, dental radiation manpower survey, and secondary data analysis to find various information about dental radiation technologists and tried to piece together the appearance of the profession of dental radiation technology in Taiwan, including the specification of job content, manpower, and their distribution. The results of this study would also have implications for the formulation of the management system for dental radiation technologists.

## Materials and methods

This study used the methods of documentary analysis, dental radiation manpower survey, and the secondary data analysis to find the profile of dental radiation technologists in Taiwan. The legal and licensing systems involving dental radiology were obtained from the websites of relevant government departments. Although there is no national list of hospitals with dental radiology departments, we conducted the dental radiation manpower survey by census through the interpersonal network of the dental radiology department of National Taiwan University Hospital (NTUH) that informally organized a group for dental radiation technologists in Taiwan. In this survey, we analyzed two questions relevant to our study: the first question was about the number of full-time dental radiation technologists by gender; and the second question was about the number of supported dental radiation technologists, and how to support full-time dental radiation technologists, when they were on leave.

In the early 2022, we used emails, messages, and communication software to send out invitations of the survey to dental radiation technologists in the hospitals, especially those who were in charge of the dental radiology department of a hospital. For those who were willing to assist in the survey, we mailed the questions by email, waited for them to fill out the questions and to send them back to us, and finally completed the collection of the survey data before May 2022. In addition, the numbers of registered dentists, physicians, and medical radiation technologists of the hospitals with completed survey were obtained from the query system in the website of the Ministry of Health and Welfare by the time of June 2022. Besides, the numbers of registered dentists, physicians and medical radiation technologists by the institution (hospital or clinic) in 2020 were obtained from the website of the Ministry of Health and Welfare. This study further compared the profile of dentists, physicians, and dental/medical radiation technologists of the hospitals, and their distributions and proportional relationship.

All secondary data were open to access and could be collected from the respective websites. The research data were stored in excel files and used for the descriptive statistics. The distribution of dental radiation technologists was analyzed by independent *t*-test and chi-square test for trend analysis. The *P*-value less than 0.05 was considered to be significant.

## Results

### Taiwan's legal and licensing systems involving dental radiology

In Taiwan, there are two official departments which supervise and govern the business about dental radiology. All operations related to dental X-ray equipment are under the management of the Atomic Energy Council based on the Ionizing Radiation Protection Act. All medical personnel related to dental radiology including dentists and medical radiation technologists are under the management of the Ministry of Health and Welfare based on the Physicians Act and Medical Radiation Technologists Act. According to the current laws and regulations, those who obtain a dentist license or a medical radiation technologist license to operate dental X-ray equipment shall receive training specified by the Competent Authority, and obtain radiation safety certificates or licenses. Therefore, oral hygienists or dental assistants are not legally allowed to operate dental X-ray equipment independently. However, they can only assist dentists in operating dental X-ray equipment. It should be noted that the content of radiation training focuses only on knowledge of ionizing radiation protection and does not include dental radiology. For dentists, the training for dental radiology (mainly the interpretation of dental radiographic images) is carried out in their dental undergraduate program under the guidance of dental teachers or senior dentists. For medical radiation technologists, the training for dental radiology (mainly the operation of dental radiation equipment) is usually conducted in their on-the-job training under the guidance of senior

dental radiation technologists in the dental radiology department of a hospital.

### Numbers of hospital, hospital with a dental department, and hospital with a dental radiology department in the dental department in different types of hospitals in Taiwan in June 2021

According to the query system of the Ministry of Health and Welfare, there were currently 466 hospitals in Taiwan (Table 1). Of the 466 hospitals, there were 4 children's hospitals, 21 medical centers, 81 regional hospitals, 359 district hospitals, and one dental hospital. All the 4 children's hospitals belonged to medical centers, while the only one dental hospital currently was categorized as a district hospital. Of the 183 hospitals with a dental department, there were 3 children's hospitals, 21 medical centers, 72 regional hospitals, 86 district hospitals, and one dental hospital. Thus, the proportions of hospitals with dental departments to each type of total hospitals were 75% for 4 children's hospitals, 100% for 21 medical centers, 88.89% for 81 regional hospitals, 23.96% for 359 district hospitals, 100% for one dental hospital, and 39.27% for 466 hospitals in overall (Table 1). In addition, of 57 hospitals with a dental radiology department in the dental department, there were 21 medical centers, 25 regional hospitals, 10 district hospitals, and one dental hospital. Thus, the proportions of hospitals with dental radiology departments to hospitals with dental departments were 100% for 21 medical centers, 34.72% for 72 regional hospitals, 11.63% for 86 district hospitals, 100% for one dental hospital, and 31.15% for 183 hospitals with a dental department in overall (Table 1). Obviously, there was a marked drop of the proportion of hospitals with a dental department to the hospitals of the same level from the regional hospitals to the district hospitals (from 88.89% to 23.96%). However, the sharp reduction of the proportions of hospitals with dental radiology departments to hospitals with dental departments was found from the medical centers to the regional hospitals (from 100% to 34.72%).

### Numbers of relevant medical personnel in hospitals with both dental and dental radiology departments and their ratios in Taiwan in June 2021

There were currently 101 dental radiation technologists in 59 dental radiology departments in 57 hospitals and their branches. According to the hospital level, of the 101 dental radiation technologists, 56 were in 21 medical centers, 28 in 25 regional hospitals, and 17 in 11 district hospitals (Table 2). Of the 57 hospitals with dental radiology departments, there were totally 1721 dentists, 3499 medical radiation technologists, and 22,248 physicians. For these medical personnel, the medical centers had the highest numbers of medical personnel, followed in a descending order by the regional hospitals and the district hospitals (Table 2).

The mean numbers of dental radiation technologist per hospital were 2.67 (56/21) for the medical center, 1.12 (28/

**Table 1** Numbers of hospital, the hospital with a dental department, and the hospital with a dental radiology department in the dental department in different types of hospitals in Taiwan in June 2021.

	Number of hospital	Number of hospital with a dental department	Number of hospital with a dental radiology department	Number of hospital with a dental department/ number of hospital	Number of hospital with a dental radiology department/number of hospital with a dental department
Children's hospital	4	3	0	75%	0
Medical center	21	21	21	100%	100%
Regional hospital	81 (87) <sup>a</sup>	72 (76) <sup>a</sup>	25	88.89%	34.72%
District hospital	359 (362) <sup>a</sup>	86 (88) <sup>a</sup>	10 (12) <sup>a</sup>	23.96%	11.63%
Dental hospital	1	1	1	100%	100%
Overall	466 (475) <sup>a</sup>	183 (189) <sup>a</sup>	57 (59) <sup>a</sup>	39.27%	31.15%

<sup>a</sup> The numbers in parentheses are the number of hospitals plus the number of their branches.

25) for the regional hospital, and 1.55 (17/11) for the district hospital, and 1.77 (101/57) for the hospital in overall. Moreover, the mean numbers of dentists, medical radiation technologists, and physicians in 57 hospitals were 30.19, 61.39, and 390.32 in overall, respectively. In addition, the medical centers also had the highest mean numbers of medical personnel, followed in a descending order by the regional hospitals and the district hospitals (Table 2).

For ratio of medical personnel, the ratios of dentists to dental radiation technologists were 20.98 for the medical center, 16.25 for the regional hospital, 5.35 for the district hospital, and 17.04 for the hospital in overall. The ratios of physicians to medical radiation technologists were 7.44 for the medical center, 4.96 for the regional hospital, 3.79 for the district hospital, and 6.36 for the hospital in overall (Table 2). Compared with the number of physicians served by each medical radiation technologist, each dental radiation technologist had to serve the higher number of dentists. Furthermore, the ratio of medical radiation technologists to dental radiation technologists was 34.64 in overall, and the ratio of physicians to dentists was 12.93 in overall. Therefore, very few number of medical radiation technologists were engaged in the field of dental radiology and worked as dental radiation technologists (Table 2).

### Pattern of dental radiology sustainment when full-time dental radiation technologists were on leave

Among 59 dental radiology departments, there were four patterns for dental radiology sustainment when full-time dental radiation technologists were on leave (Table 3). Due to insufficiency of dental radiation technologist manpower, these four patterns were used in order of frequency from high to low as follows. First, the dental radiology department had more than two full-time dental radiation technologists on duty, thus there was usually no need for the support from other medical personnel. Most dental radiology departments (40.68%, 24/59), especially those in the medical centers (28.81%, 17/59), adopted this pattern. Second, when full-time dental radiation technologists were on leave, dental radiology work was performed by dentists themselves. More than one-third of dental radiology departments (38.98%, 23/59), especially those in the regional

hospitals (20.34%, 12/59) and those in the district hospitals (13.56%, 8/59), adopted this pattern (Table 3). Third, when full-time dental radiation technologists were on leave, dental radiology work was supported by medical radiation technologists from the Departments of Diagnostic Radiology or Imaging Medicine in the same hospitals. Some dental radiology departments (11.86%, 7/59), especially those in the regional hospitals (8.47%, 5/59), adopted this pattern. Fourth, there was no standing full-time dental radiation technologist, thus dental radiology work was routinely supported by medical radiation technologists from the Departments of Diagnostic Radiology or Imaging Medicine. Some dental radiology departments (8.47%, 5/59), especially those in the regional hospitals (6.78%, 4/59), adopted this pattern (Table 3).

### Distribution and comparison of full-time dental radiation technologists by the gender, hospital level, and hospital location in Taiwan in June 2021

Of 101 full-time dental radiation technologists, there were 29 male dental radiation technologists and 72 female dental radiation technologists (Table 4). To compare the distribution of full-time dental radiation technologists by gender, hospital level, and hospital location, the number of female dental radiation technologists was higher than the number of male dental radiation technologists regardless of hospital level or hospital location. However, proportionally, there were more female dental radiation technologists than male dental radiation technologists in the district hospital (76.47%, 13/17) and in the northern region of Taiwan (74.14%, 43/58) (Table 4). On the other hand, according to the hospital level, there were 56 dental radiation technologists in the medical centers, 28 in the regional hospitals, and 17 in the district hospitals. According to the hospital location, there were 58 dental radiation technologists in the northern region, 25 in the central region, 17 in the southern region, and only one in the eastern region of Taiwan. More than half of the dental radiation technologists were concentrated in the medical centers (55.45%, 56/101) or northern region (57.43%, 58/101), especially in the northern medical centers (30.69%, 31/101) in Taiwan (Table 4).

**Table 2** Numbers of relevant medical personnel in hospitals with dental department and dental radiology department and their ratios in Taiwan in June 2021.

	Medical center (n = 21)	Regional hospital (n = 25)	District hospital (n = 11)	Overall (n = 57)
Number of medical personnel				
Dental radiation technologist	56	28	17	101
Dentist	1175	455	91	1721
Medical radiation technologist	2077	1203	219	3499
Physician	15,454	5963	831	22,248
Mean number of medical personnel				
Dental radiation technologist	2.67	1.12	1.55	1.77
Dentist	55.95	18.2	8.27	30.19
Medical radiation technologist	98.90	48.12	19.91	61.39
Physician	735.90	238.52	75.55	390.32
Ratio of medical personnel				
Dentists to dental radiation technologists	20.98	16.25	5.35	17.04
Physicians to medical radiation technologists	7.44	4.96	3.79	6.36
Medical radiation technologists to dental radiation technologists	37.09	42.96	12.88	34.64
Physicians to dentists	13.15	13.11	9.13	12.93

**Table 3** Four different patterns of dental radiology sustainment when full-time dental radiation technologists were on leave.

	Medical center	Regional hospital	District hospital	Overall
With more than two full-time dental radiation technologists on duty, there is usually no need for the support from other medical personnel.	17	4	3	24
When full-time dental radiation technologists are on leave, dental radiology work is performed by dentists themselves.	3	12	8	23
When full-time dental radiation technologists are on leave, dental radiology work is supported by medical radiation technologists from the Departments of Diagnostic Radiology or Imaging Medicine.	1	5	1	7
Without standing full-time dental radiation technologist, dental radiology work is routinely supported by medical radiation technologists from the Departments of Diagnostic Radiology or Imaging Medicine.	0	4	1	5
Overall	21	25	13	59

The mean numbers of full-time dental radiation technologists were calculated by each dental radiology department for gender and overall. Those were also calculated by each dental radiology department under the same hospital level and hospital location. Among 59 dental

radiology departments, the mean numbers of dental radiation technologists were 0.49 for male, 1.22 for female, and 1.71 for overall (Table 5). The mean number of female dental radiation technologists was significantly higher than that of male dental radiation technologists ( $P < 0.0001$ ).

**Table 4** Distribution of full-time dental radiation technologists by gender, hospital level, and hospital location in Taiwan in June 2021.

	Gender		Total	Chi-square test
	Male	Female		P-value
Hospital level				$P = 0.862$
Medical center	17	39	56	
Regional hospital	8	20	28	
District hospital	4	13	17	
Total	29	72	101	
	Gender		Total	Chi-square test
	Male	Female		P-value
Hospital location				$P = 0.733$
Northern region	15	43	58	
Central region	9	16	25	
Southern region	5	12	17	
Eastern region	0	1	1	
Total	29	72	101	
	Hospital level			Chi-square test
	Medical center	Regional hospital	District hospital	P-value
Hospital location				$P = 0.790$
Northern region	31	15	12	58
Central region	13	8	4	25
Southern region	11	5	1	17
Eastern region	1	0	0	1
Total	56	28	17	101

For the hospital level, the mean numbers of dental radiation technologists were 2.67 for the 21 medical centers, 1.12 for the 25 regional hospitals, and 1.31 for the 13 district hospitals (Table 5). The mean number of dental radiation technologists for 21 medical centers was significantly higher than that for the 25 regional hospitals ( $P < 0.0001$ ) and that for 13 district hospitals ( $P < 0.001$ ) (Table 5).

For the hospital location, the mean numbers of dental radiation technologists were 1.87 for the 31 hospitals with dental radiology departments in the northern region, 1.92 for the 13 hospitals with dental radiology departments in the central region, 1.31 for the 13 hospitals with dental radiology departments in the southern region, and 0.5 for the 2 hospitals with dental radiology departments in the eastern region of Taiwan (Table 5).

**Table 5** Comparison of mean number of full-time dental radiation technologists by gender, hospital level, and hospital location in Taiwan in June 2021.

Category	Dental radiation technologists	Comparison (independent <i>t</i> -test)	
	Mean $\pm$ SD	Group	P-value
Gender			
Male	0.49 $\pm$ 0.65	Female > Male	$P < 0.0001$
Female	1.22 $\pm$ 1.05		
Hospital level			
Medical center	2.67 $\pm$ 1.32	Medical center > Regional hospital	$P < 0.0001$
Regional hospital	1.12 $\pm$ 0.78	Medical center > District hospital	$P < 0.001$
District hospital	1.31 $\pm$ 0.95	District hospital > Regional hospital	$P = 0.273$
Hospital location			
Northern region	1.87 $\pm$ 1.31	Central region > Eastern region	$P = 0.068$
Central region	1.92 $\pm$ 1.26		
Southern region	1.31 $\pm$ 1.03		
Eastern region	0.5 $\pm$ 0.71		
Overall	1.71 $\pm$ 1.25		

SD: Standard deviation.

## Discussion

In Taiwan, in addition to dentists, only medical radiation technologists have legal authority to operate dental X-ray equipment. However, there is no independent licensing system for the dental radiation technologists. Therefore, how to become a dental radiation technologist is a complex and circuitous process in Taiwan. First, he or she must be a graduate with an associate degree or above in the school of medical imaging and radiological sciences. Second, he or she needs to pass the national examination to obtain the qualification and certificate of medical radiation technologist. Third, he or she needs to receive training specified by the competent authority, and passes the examination to obtain the radiation safety certificate, and then he or she has the right to operate X-ray equipment. Fourth, he or she needs to apply for the radiology department of a dental institution (usually a hospital), and then receives on-the-job dental X-ray equipment operation training to engage in the dental radiology job. Eventually, he or she becomes the so-called dental radiation technologist in Taiwan's current dental system. In fact, we do not have a separate license for the dental radiation technologist profession. Essentially, dental radiation technologists are medical radiation technologists who work in the dental radiology departments in the hospitals.

There is an independent licensing system for dental radiation technologists in the United States. Dental radiation technologist means an individual who practices dental radiation technology other than a licensed dentist or a licensed dental hygienist. A certified dental radiation technologist shall perform the duties of a dental radiation technologist under the direct supervision of a licensed dentist. For example, a dental assistant must be state-certified as a dental radiation technologist to legally operate dental x-ray equipment and perform dental radiographic procedures in Maryland. To obtain this state certificate, he or she must be at least 18 years of age, holds a high school diploma or its equivalent, successfully completes a dental radiography course (minimum of 24 h), passes the certified dental assistant examination, and then applies for state certification after completing all of the above requirements. It should be noted that on-the-job training does not qualify a dental assistant to operate dental x-ray equipment and perform dental radiographic procedures in Maryland. This is the so-called dental assistant-certified radiation technologist or dental radiographer.<sup>10</sup> On the other hand, once students graduate with an associate or a bachelor degree in radiologic technology, they take the American Registry of Radiologic Technologists certification examination. Most states require licenses as well. As of 2018, according to the American Society of Radiologic Technologists website, [www.asrt.org](http://www.asrt.org), 42 states require a radiography license, meaning a radiologic technologist can work on the human body, including a patient's teeth and surrounding soft tissue.<sup>11</sup>

In Taiwan, there is no independent system for dental assistant-certified radiation technologists. Therefore, an individual who practices dental radiation technology other than a licensed dentist can only be a licensed medical radiation technologist. However, there are only a few dental

radiation technologists in Taiwan. Among 183 hospitals with a dental department, only 57 (31.15%) hospitals had independent dental radiology departments, while among 189 dental departments in the hospitals, only 54 (28.57%) dental departments had dental radiology departments with standing full-time dental radiation technologists (Table 3). There were only 101 full-time dental radiation technologists working in these dental radiology departments. Their work content was performing dental radiology for panoramic, periapical, occlusal, cephalometric, temporomandibular joint, and cone-beam computed tomography (CBCT) images. In the dental hospital, however, the work content also included performing medical radiology for the inpatients. In Taiwan, there are some medical care radiological clinics for dentistry. There are also very few dental clinics that employ medical radiation technologists to do the dental radiology works. However, the work content of the dental radiation technologists in these medical care radiological clinics or dental clinics was not covered in this study.

Among 59 dental radiology departments in hospitals, 101 dental radiation technologists were only 2.89% of all medical radiation technologists (101/3499) (Table 2). However, there are 6873 registered medical radiation technologists in Taiwan in 2020, which means that proportionally there are indeed very few medical radiation technologists who work for dental radiology in Taiwan. More than half (59.32%, 35/59) of the dental radiology departments in hospitals needed other medical radiation technologists to support dental radiology works or dentists themselves to perform dental radiology when there was no dental radiation technologist on duty (Table 3). So far as we know, dental radiology in dental clinics is almost performed by the dentists themselves. In this study, the ratios of dentists to dental radiation technologists and physicians to medical radiation technologists were 17.04 and 6.36, respectively (Table 2). This means that dentists rely less assistance from radiation technologists than physicians. In addition to the small number of dental radiation technologists, the reasons for this are that the undergraduate dental course has dental X-ray equipment operation training, and all dentists have the ability to perform dental radiology.

In this study, the male to female ratio of dental radiation technologists was about 1:2.48 (Table 4). The numbers of female dental radiation technologists were higher than those of male dental radiation technologists among all levels and regions of the hospitals. This finding indicates that more female medical radiation technologists are employed in dental radiology departments of hospitals and they tend to have a higher willingness to work in dental radiology department to become a dental radiation technologist. We also found that the manpower of dental radiation technologists is still unevenly distributed. Among 59 dental radiology departments of 57 hospitals, 31 dental radiology departments of 29 hospitals were in the northern region of Taiwan, and more than half (57.43%, 58/101) of dental radiation technologists were in the northern region of Taiwan, especially in the northern medical center (30.69, 31/101). There were only 2 hospitals with dental radiology departments in the eastern region of Taiwan. Moreover, there was only one dental radiation technologist in this region (Table 4). In addition, the mean numbers of dental radiation

technologists in the medical centers or in the northern and central regions of Taiwan were higher than those in other level hospitals or in other regions of Taiwan, respectively (Table 5). Our previous studies found that the uneven distribution of dental resources is a long-standing problem in Taiwan. This problem includes not only the uneven distribution of dentists and dental institutions,<sup>12–15</sup> as well as dental students and dental education resources,<sup>16–19</sup> but also the uneven distribution of various dental-related personnel such as dental radiation technologists, oral hygienists, dental technicians, and dental nurses.

The medical radiation technologists predominantly engage in diagnostic radiology, and rarely engage in dental radiology. The medical radiation technologists who engage in dental radiology are so-called dental radiation technologists. In the field of dentistry, there are no such personnel as dental assistant-certified radiation technologists or dental radiographers in Taiwan's dental system.

In the field of medical radiation, there are 10 schools of radiological technology in Taiwan. However, these 10 schools offer few dental radiology courses for their undergraduate students. It means that there is no relevant system for training dental radiation technologists in the education of radiological technology. In addition, there are also few dental radiology courses for dental undergraduate students in Taiwan's dental schools.<sup>20</sup> Therefore, in Taiwan, a licensed medical radiation technologist engages in dental radiology with minimal on-the-job training, while a licensed dentist performs dental radiology with few related dental radiology courses. Furthermore, in Taiwan, dentists mainly practice in the dental clinics, while medical radiation technologists mainly practice in the hospitals. In fact, the majority of dentists in the local clinics do not rely on dental radiation technologists to assist in the work of dental radiography.

At present, there is no consensus between the dentistry profession and the medical radiation profession as well as no consensus on whether Taiwan needs the licensing system for dental assistant-certified radiation technologist. However, no matter from the perspective of dentistry or medical radiation, in the future, a dental radiology education system should be established to include both the design of advanced dental radiology courses for dental students and the design of innovative dental radiology courses for radiological technology students. This in turn can provide a new practice direction for medical radiation technologists and expand their potential participation in the field of dental radiology.

## Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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