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Perspective article

Current situation, challenges, and future prospects of the dental radiology education for the medical radiation students in Taiwan

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Taiwan's medical imaging education is at a critical juncture of digital transformation and functional expansion in the dental radiology education. Traditional radiology courses often focus on imaging using large equipment (such as computed tomography, magnetic resonance imaging, and angiography). However, dental radiology frequently reduced to a small unit within the course of general radiography.[1,2] This results in lacking sufficient mastery of the detailed techniques and angles of intraoral radiography (such as periapical radiography, bite-wing radiography, and occlusal radiography) for the medical radiation students. To address this market gap, several universities (such as Kaohsiung Medical University and Yuanpei University of Medical Technology) have established dental radiology as a separate course or a "Dental Imaging Technology Program", increasing course hours and making it a required or elective course for their third-year or fourth-year students. In this article, we attempted to explore an overview of the dental radiology education for the medical radiation students in Taiwan through an interview with a senior and experienced medical imaging teacher.

In this study, we used purposeful sampling to select a medical imaging teacher who had extensive experience in the career of medical imaging education to conduct an interview with him. The outline of our questions for the medical imaging teacher and the key points of his answers during the interview are shown in Table 1. The interview outline had 4 major items related to the dental radiology education for the medical radiation students in Taiwan, including (A) the current situation, (B) the challenges, (C) the necessity, and (D) the future prospects.

Based on the interview, we summarized the key points regarding the dental radiology education for the medical radiation students in Taiwan as follows:

(A) The current situation of the dental radiology education for the medical radiation students in Taiwan: (1) Curriculum integration and functional enhancement: Medical radiology professional groups were actively promoting the inclusion of "dental photography skills" as a key job function for the medical radiation technologists. Currently, some medical imaging schools (such as Kaohsiung Medical University) have added a "Dental Imaging Technology Program" to enhance students' diverse employment opportunities. (2) Clinical internship model in the teaching hospitals: The teaching hospitals (such as the Department of Dentistry of National Taiwan University Hospital) have specialized training programs for the medical radiation interns, including practical assessments of intraoral and extraoral radiography, cone-beam computed tomography (CBCT) scans, etc. (3) Application of digital equipment: Some dental schools (such as Chung Shan Medical University) have established digital laboratories, introducing virtual reality (VR) interactive equipment and intraoral scanners to align with the trend of digital teaching.

(B) The challenges of the dental radiology education for the medical radiation students in Taiwan: (1)

Table 1 The questions for the medical imaging teacher and the key points of his answers during the interview in this study.

	The questions for the medical imaging teacher and his answers
Question 1	What is the current situation of the dental radiology education for the medical radiation students?
Key points	The dental radiology education for the medical radiation students in Taiwan is undergoing functional expansion and digital transformation. The current situation includes the following key aspects: (1) curriculum integration and functional enhancement; (2) clinical internship model in the teaching hospitals; and (3) application of digital equipment.
Question 2	What challenges does the dental radiology education for the medical radiation students face in Taiwan?
Key points	The dental radiology education for the medical radiation students in Taiwan is still in its early stages. Currently, it faces several key challenges, including (1) inconsistent faculty and curriculum standards; (2) shortage of the medical radiation technologists engaged in the dental radiology; and (3) incomplete regulations and credit accreditation system.
Question 3	Is the dental radiology education necessary for the medical radiation students?
Key points	For the medical radiology students, studying dental radiology is not only an extension of their professional skills, but also a necessary process to meet regulatory requirements and enhance their competitiveness in the job market. Its necessity lies in the following key aspects: (1) regulatory compliance and occupational safety; (2) expanding diverse employment opportunities; (3) enhancing workplace competitiveness and professionalism; (4) interdisciplinary communication and integration with the clinical practice; and (5) meeting the needs of an aging society.
Question 4	What are the future prospects for the dental radiology education for the medical radiation students in Taiwan?
Key points	With the development of the dental radiology, the future prospects for the dental radiology education for the medical radiation students in Taiwan include the following key development areas: (1) integration of artificial intelligence (AI) and precision medicine; (2) establishment of a standardized education system; and (3) internationalization and specialization.

Inconsistent faculty and curriculum standards: The research indicates that a unified standard for the dental radiology internships has not yet been established between the medical imaging schools and the teaching hospitals in Taiwan. Furthermore, the teaching hospitals generally face a severe shortage of dental radiology instructors. (2) Shortage of the medical radiation technologists engaged in dental radiology: Currently, many grassroots dental clinics lack professional medical radiation technologists, forcing the dentists to operate the equipment by themselves. The pathways and incentives for the medical radiation graduates to enter the dental profession need to be strengthened. (3) Incomplete regulations and credit accreditation system: Under the current system, the qualified dentists who have completed general radiation protection training and the qualified medical radiation technologists can obtain dental radiology operating licenses for life.[3,4] However, there is a lack of a regular renewal mechanism specifically for the dental field, which poses a challenge to promote a higher level of specialization in the dental radiology.

(C) The necessity of the dental radiology education for the medical radiation students in Taiwan: (1) Regulatory compliance and occupational safety: According to Taiwan's regulations, dental X-ray equipment must be performed by the qualified dentists who have completed general radiation protection training or by the qualified medical radiation technologists. Through systematic learning, the medical radiation students can more accurately implement the Reasonable Minimization of Radiation Exposure (ALARA) principle, ensuring image quality while minimizing the radiation risks to the patients and medical personnel. (2) Expanding diverse employment opportunities: The role of the medical radiation technologists is no longer limited to the large hospitals. The professional groups regarding the medical radiology are actively urging the medical imaging schools to add the dental radiology courses to meet workplace demands. Mastering dental radiology techniques (such as periapical radiography, panoramic radiography, and dental CBCT) equips the students with the professional skills to work in the dental clinics, chain dental groups, or orthodontic centers, significantly increasing employment opportunities. (3) Enhancing workplace competitiveness and professionalism: Dental imaging requires extremely high spatial resolution, and the shooting angles (such as bisector techniques) are more detailed than those used in general radiography. After studying the dental radiology, students are familiar with the operation of advanced equipment such as dental CBCT. This is an indispensable technical indicator in the modern precision dental implantation and root canal treatment. (4) Interdisciplinary communication and integration with the clinical practice: The medical radiation students need basic dental anatomy knowledge to immediately assess the diagnostic value of dental radiographs after imaging (e.g., whether root apex is included, or whether there is an overlap), and to communicate with the dentists. Familiarity with these processes is crucial for the students' learning and future career transition. (5) Meeting the needs of an aging society: With Taiwan entering a super-aged society by 2025, the demand for full-mouth denture reconstruction and image-guided dental surgery is surging. The medical radiation technologists possess professional dental image processing skills, enabling them to collaborate with the dentists, shortening the diagnostic time, and improving the quality of dental care.

(D) The future prospects of the dental radiology education for the medical radiation students in Taiwan: (1) Integration of artificial intelligence (AI) and precision medicine: As Taiwan enters a super-aged society by 2025, the dental radiology will combine AI technology for automatic disease detection and 3D printing applications (such as denture fabrication), improving diagnostic efficiency and accuracy. (2) Establishment of a standardized education system: The future goal is to establish a standardized dental radiology education system, including mandatory dental courses within the medical imaging schools and standardized internship programs and hours, enabling the medical radiation interns to independently operate the dental X-ray machines upon completion of training. (3) Internationalization and specialization: The professional groups regarding the medical radiology is actively promoting continuing education courses and international certification in the dental radiology, and encouraging the medical radiation technologists to develop towards advanced diagnostic and technical management skills to avoid being completely replaced by the automated tools.

Based on the interview above, the following conclusion can be drawn regarding the dental radiology education for the medical radiation students in Taiwan: The dental radiology is a crucial piece of the puzzle for the medical radiation students to expand their career prospects, improve the professional accuracy, and ensure the radiation safety. Establishing unified educational standards, broadening the scope of clinical internships, and promoting the widespread use of the medical radiation technologists in the dental clinics will be key steps in improving the overall quality of oral healthcare in Taiwan.[5]

Declaration of competing interest

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

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