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Ethical implications and moral considerations of artificial intelligence in dentistry: Potential challenges in dental restoration fabrication

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The evolution of artificial intelligence (AI) has accelerated advancements in the medical field. In dentistry, the AI has been increasingly adopted to assist in clinical treatment processes, including diagnostics, postoperative model simulations, and dental restoration fabrication.[1] However, while the AI brings convenience to oral and dental health care, it also raises the ethical and moral concerns.[2] For the patients, the undergoing treatment provided by the dentists and dental technicians with professional training backgrounds offers a relatively safe and secure health care experience. Although the AI is built upon extensive dental expertise and clinical case data, it cannot guarantee that the overseer possesses adequate dental professional knowledge. Traditionally, the patients required evaluations and diagnoses from the dentists before the dental technicians could design their dental restorations. After receiving approval from the dentists, the restorations were fabricated, finally completing the treatment processes (Fig. 1A). At present, the AI can assist the dental technicians in the design phase of restorations, but the final treatment plan remains under the supervision of the dentists (Fig. 1B). As the AI advances, it is anticipated that certain treatment tasks—such as the evaluation, design, and fabrication—may be performed directly by the AI, potentially bypassing the involvement of the dentists and dental technicians (Fig. 1C). This implies that individuals without dental expertise might use the AI systems to perform the similar medical tasks, which could compromise the professional oversight essential to the treatment planning. In fact, the entire medical process involves both executors and supervisors. This is analogous to a dentist issuing a prescription, where the dental technician follows the instructions to fabricate the restoration. Ultimately, the dentist fits the restoration in the patient's oral cavity to complete the treatment. If the patient is treated bypassing the dentist and the AI is utilized independently for the oral and dental treatment, the efficacy and safety of the treatment will not be guaranteed.

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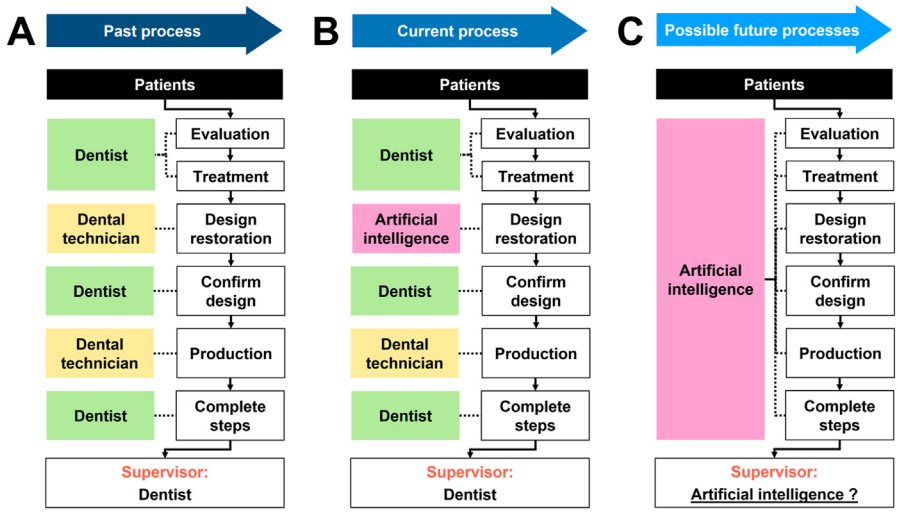

Figure 1 Evolution of the dental restoration workflows and the role of artificial intelligence (AI). (A) In the traditional process, the dentists evaluated and treated the patients, while the dental technicians designed and fabricated the dental restorations based on the dentist prescriptions, with final design confirmation and overall supervision by the dentists. (B) In the current process, the AI assists the dental technicians in designing restorations, while the dentists remain responsible for evaluation, treatment, design confirmation, and overall supervision, with the dental technicians managing production. (C) In the future, the AI can centralize the evaluation, treatment planning, design, and production, potentially reducing the roles of the dentists and dental technicians, and raising questions about supervision as well as the ethical and moral concerns.

In recent years, more and more studies have begun to explore the impact of the AI on the oral and dental health care. The introduction of the AI facilitates and improves the clinical work of the dental technicians.[3] However, the AI raises concerns regarding the job security, ethical considerations, and training for the dental technicians. While the AI holds promise in predicting, diagnosing, making decision, customizing treatment plans, and managing patients, the ethical issues must be addressed during its implementation.[4] Only when the AI is used responsibly, ethically, and universally can it contribute substantially to oral and dental health care. The ethical concerns related to the AI include issues of data privacy, system bias, and the potential for the AI to replace the human roles.[5] Consequently, the comprehensive training and the establishment of regulatory frameworks are urgently needed to resolve the ethical challenges. Furthermore, as the regulations governing the dental restoration fabrication vary across countries, it is essential to consider whether the AI applications may conflict with the regulatory restrictions. Some countries have explicit regulations requiring dental restorations to be fabricated by the dentists or dental technicians. The appropriateness of the AI implementation should be independently interpreted and regulated based on the specific requirements of each region.

Although the challenges persist, the outlook for the AI in dentistry should remain optimistic. With the well-established ethical, moral, and legal frameworks, the clinical applications of the AI in dentistry hold vast potential for the future advancements.

Declaration of competing interest

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

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Wei-Chun Lin
School of Dental Technology, College of Oral Medicine, Taipei Medical University, Taipei, Taiwan
Department of Dentistry, Wan-Fang Hospital, Taipei Medical University, Taipei, Taiwan

Feng-Chou Cheng**
Chia-Te Dental Clinic, New Taipei City, Taiwan
School of Life Science, College of Science, National Taiwan Normal University, Taipei, Taiwan
Science Education Center, National Taiwan Normal University, Taipei, Taiwan

Yu-Chieh Lin
Digital Medicine Center, Translational Health Research Institute, Vilnius University, Vilnius, Lithuania
Institute of Research, Development and Innovation, IMU University, Kuala Lumpur, Malaysia

Chun-Pin Chiang*
Department of Dentistry, National Taiwan University Hospital, College of Medicine, National Taiwan University, Taipei, Taiwan
Graduate Institute of Oral Biology, School of Dentistry, National Taiwan University, Taipei, Taiwan
Department of Dentistry, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Hualien, Taiwan
Institute of Oral Medicine and Materials, College of Medicine, Tzu Chi University, Hualien, Taiwan

**Corresponding author. Chia-Te Dental Clinic, No. 10, Lane 308, Chongqing Road, Banqiao District, New Taipei City 220, Taiwan.
E-mail address: 894430051@ntnu.edu.tw (F.-C. Cheng)

*Corresponding author. Department of Dentistry, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, and Institute of Oral Medicine and Materials, College of Medicine, Tzu Chi University, No. 707, Section 3, Chung-Yang Road, Hualien 970, Taiwan.
E-mail address: cpchiang@ntu.edu.tw (C.-P. Chiang)

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