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The impact of artificial intelligence evolution on the dental morphology sculpting education

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Human teeth exhibit a high degree of morphological diversity, with variations manifested in the tooth size, the number and arrangement of cusps, the fissure depth, the surface contours, and the wear patterns.[1] These morphological differences are influenced by multiple factors, including genetic background, functional demands, occlusal relationships, and individual usage habits. Even within the same tooth type, such as the maxillary first molar demonstrated in this article (Fig. 1), significant morphological differences can be observed among individuals. Such diversity demonstrates that the dental morphology education cannot rely solely on a single standard model but must cultivate students' holistic understanding of the dental anatomy and morphological variation.[2] Therefore, both the clinical dentists and dental technicians must receive comprehensive training in the dental morphology during their professional education to establish a solid foundation for clinical and technical practice.

Currently, the dental morphology sculpting education can be broadly classified into three approaches: the traditional plaster carving, the digital software–based design, and the artificial intelligence (AI)–assisted design (Fig. 1). The traditional plaster carving has long been used as a fundamental training method for the dentists and dental technicians.[3] Through manual carving, a rectangular plaster block is sculpted to gradually conform to the natural morphology of tooth development (Fig. 1A). This process enables the students to develop spatial awareness and hand–eye coordination, while gaining a deeper understanding of the dental anatomy and morphology (Fig. 1B and C). With the advancement of digital dental technology, the digital design software has been introduced into the dental education, allowing for the visualization and standardization of the tooth morphology and improving design efficiency.[4] The digital software–based design using the dental digital software, such as inLab SW 16.1 (Dentsply Sirona, Charlotte, NC, USA), typically includes an integrated tooth morphology database, in which the preset shapes closely resemble the final tooth morphology (Fig. 1D). The dental technicians can complete the tooth design by making personalized and detailed modifications based on these database models (Fig. 1E and F). In recent years, the AI–assisted design is gradually maturing, as the AI technology has been further applied to the tooth morphology design.[5] The dental digital design software is increasingly incorporating AI modules for various restorative applications, with the particularly rapid development observed in fixed prosthodontics. For example, Dentbird® Crown (Imagoworks®, Seoul, Republic of Korea) automatically generates the tooth morphology using a built-in morphological database. However, the teeth generated by AI tend to exhibit high similarity when produced under identical conditions, resulting in repetitive designs (Fig. 1G). Although the AI technology can significantly shorten the design time and improve the workflow

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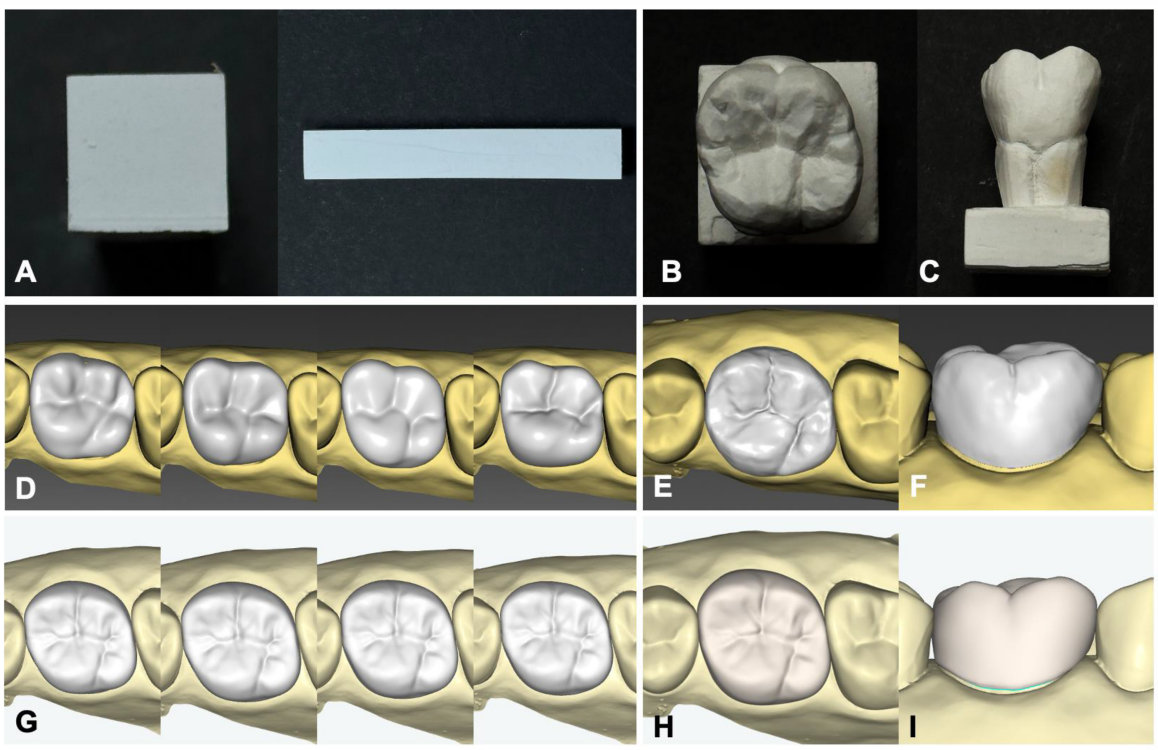

Figure 1 The educational models for the dental morphology. (A) Top and side views of an uncarved plaster model. (B and C) A plaster model sculpted to demonstrate the occlusal view (B) and buccal view (C) of the left maxillary first molar. (D) A built-in database of the tooth morphology within the dental digital design software. (E and F) The digital designs of the occlusal profile (E) and buccal view (F) of the left maxillary first molar. (G) The repeated designs by the artificial intelligence (AI) software for the shape of the molars. (H and I) The AI—assisted designs of the occlusal profile (H) and buccal view (I) of the left maxillary first molar.

efficiency, human intervention remains necessary to achieve the optimal harmony in the tooth morphology (Fig. 1H and I).

Despite the significant improvements in efficiency brought about by the digitalization and AI technologies in the dental morphology design, the dental morphology education continues to face important challenges. Although the AI- and database-driven automated generation systems can rapidly produce the anatomically accurate tooth forms, the excessive reliance on automated processes may weaken students' understanding of the fundamental morphological structures and their manual sculpting skills. In contrast, the traditional plaster sculpting, while time-consuming, remains an indispensable training method for establishing a solid foundation in the dental morphology recognition and technical competence. Therefore, the students should first learn to gradually sculpt a complete tooth form from an uncarved plaster block, thereby developing the fundamental skills before integrating the digital tools and AI-assisted design into their workflow. Such foundational training helps to prevent situations in which the students are unable to appropriately modify the tooth morphology or interpret the design recommendations when using advanced digital systems. Future dental morphology education should move toward a blended learning model that integrates the traditional techniques, digital design, and AI to ensure that the students acquire both the essential manual skills and advanced technological application capabilities.

Declaration of competing interest

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

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