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Deep Learning-Based Workflow of Removable Denture Base and Teeth Arrangement

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Objectives To introduce a novel digital design workflow powered by deep learning (DL) to arrange artificial teeth and design removable partial denture base.

Methods The proposed workflow is about an automated design process of removable partial denture base and arrangement of artificial teeth powered by DL. A total of 15 partially edentulous cases were de-identified and collected as test scan data. In brief, an DL-based design software (Dentbird Crown) generated artificial teeth in missing regions of each scan data, considering adjacent and antagonistic teeth. The software was powered by the models composed of pixel2style2pixel (pSp) encoder and StyleGAN generator, and trained with a modern image-to-image translation schema. The software automatically removed undercut area along the optimal insertion paths and generated denture bases according to user-defined border. It can produce voxel-based signed distance fields (SDF) of desired bases by considering the SDF of artificial teeth and edentulous area. This utilizes a U-shape network to achieve consistent mapping between the SDF, addressing its task as a regression problem. For each step, average working time was measured. All designed denture bases and artificial teeth were fabricated with dental resins by using digital light processing for their physical evaluation.

Results Average working time was measured as 6.1 seconds for artificial teeth arrangement, 25.5 seconds for undercut area removal, and 1.4 seconds for denture base generation. Based on this workflow, the virtual outcome is shown in Figure 1 and physical outcome in Figure 2.

Conclusions This pilot study introduced a novel DL-based workflow to arrange artificial teeth and design removable partial denture base. This automated process can be useful to simplify the workflow.