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Predictable 3D-printed surgical guide for hemisection of a double tooth with complete fusion to apex: A case report

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Computer aided design;
Fused tooth;
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Hemisection is the complete surgical splitting of a fused tooth into two teeth, each with a separate crown and root. It has the advantage of allowing half of the tooth to be reconsturcted.[1,2] However, if the canal configuration or location within the bone is not properly confirmed, pulp exposure and inappropriate root shaping may occur. In this study, we presented a novel hemisection technique with enhanced precision for a fused tooth, based on digital dentistry.

A healthy 7-year-old boy visited our clinic, with chief complaint of a supernumerary tooth. There was a supernumerary tooth next to the left maxillary lateral incisor, and the two teeth were found to be fused from crown to root apex. Besides, there was communication of pulp between the teeth (Fig. 1a–c). The patient was followed for 4 years until the communication disappeared (Fig. 1d–f). Then hemisection was planned. The tooth to be extracted was selected considering the mesiodistal width of the crown.

A digital impression was taken and saved as STL file. Using a 3-dimensional (3D) treatment planning software (BlueSkyPlan 4.7.5, BlueSkyBio, Libertyville, IL, USA), cone beam computed tomography (CBCT) images were merged with scanned intraoral images. Moreover, a surgical guide was designed with 3D design tool (Meshmixer 3.5, Autodesk, San Rafael, CA, USA). The guide was printed with 3D printer (DIO PROBO Z, Dio Co., Busan, Korea) (Fig. 1g–m).

A mucoperiosteal flap was elevated after local anesthesia, and the guide was placed in the surgical field. The fused tooth was separated using a diamond bur (G858-314-012-8-ML, Diatech Dental Instruments, Heerbrugg, Switzerland). The mesial portion of fused tooth was extracted and TERUPLUG® (Termo Co., Tokyo, Japan) was applied to the socket. The root surface of remained tooth was additionally prepared to promote periodontal attachment and treated with Emdogain (Biora AB, Malmö, Sweden), and the flap was sutured (Fig. 1n–s).

After 4 months, the patient showed no clinical symptoms and partial bony healing of the socket (Fig. 1t–x). Moreover, the CBCT images were taken again and the tooth was scanned for the precision assessment (Fig. 1y).

Hemisection has potential challenges, including a compromised visibility due to bleeding, and difficulty in using cutting burs with correct angle.[3] In particular, in this case, this consideration was necessary because the fusion extended to the apex in parallel form. Our guide was implemented to optimize the bur angle, enabling fast and accurate surgery even in challenging visibility conditions. Furthermore, the discrepancies between the designed cutting surface and the postoperative outcomes were all

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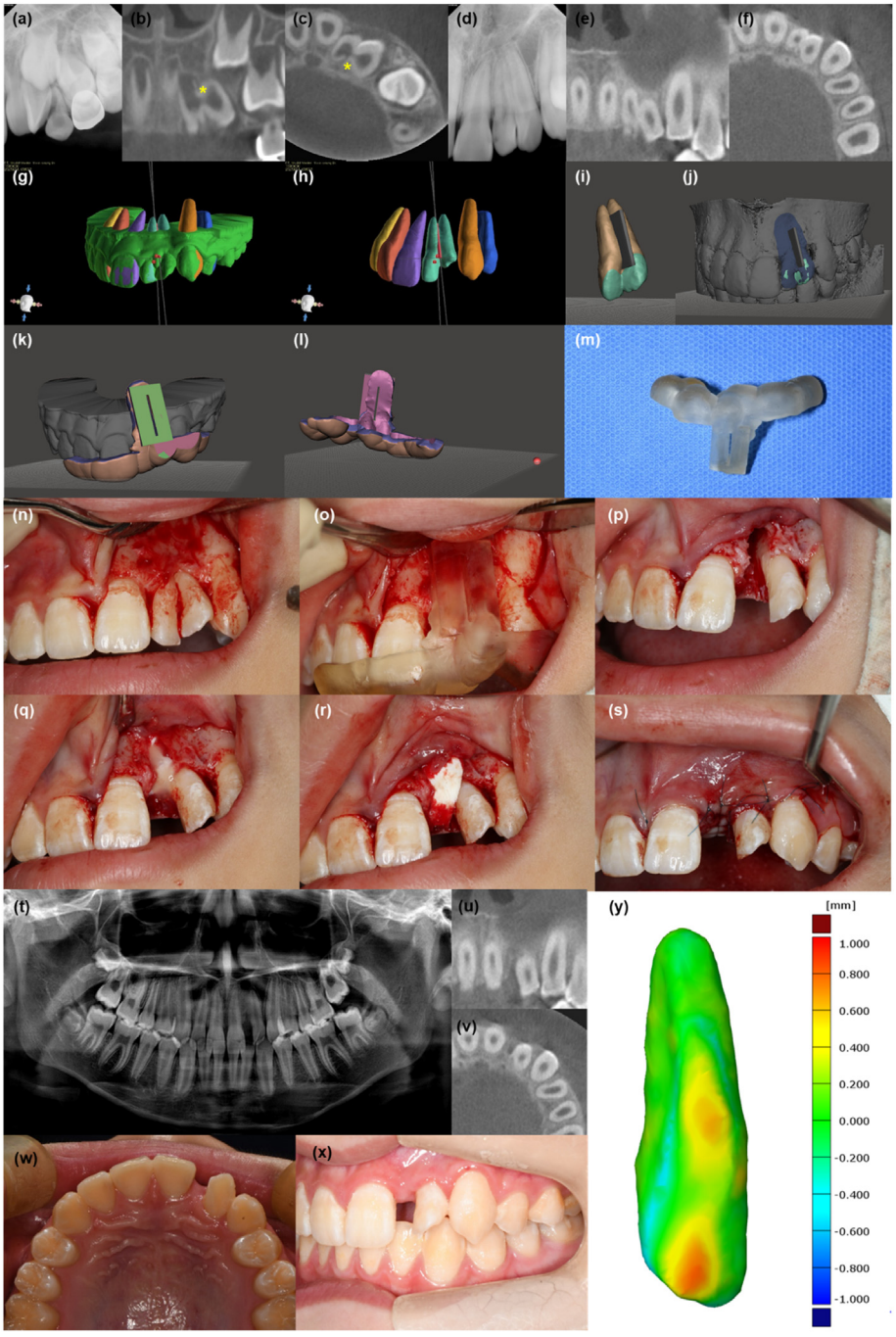

Figure 1 Hemisection of a fused tooth. (a—c) Radiographic examination at the initial visit. A double tooth was observed and the tooth was diagnosed as fusion between left maxillary lateral incisor and supernumerary tooth. Note that communication in the root canal in the tooth (yellow asterisk). (d—f) Radiographic examination at 3.5 year-follow up. There was no sign of pulp communication in the double tooth. (g) Digital merging of CBCT and scanned images, (h—j) Determination of 3D orientation of cutting path (gray plane). The path was designed as a plane that divides the roots and crowns of the two teeth without contacting the pulp of the teeth. (k) Design of the 3D-printed hemisection guide. Considering the size of bur, the window width of the guide was set to 1 mm and the depth to 9.1 mm. It was designed to cover from the right maxillary central incisor to the left maxillary first premolar to have appropriate retention. (l) Inner surface of guide. Inner surface of the guide was designed to directly touch the alveolar bone surface. (m) Image of a the 3D-printed hemisection guide. (n) A full-thickness flap was elevated and alveolar bone was exposed. (o) Delivery of the 3D-printed hemisection guide. (p) Hemisection. The mesial part of a double tooth was extracted. (q) Enamel matrix derivative application to the denuded root surface. (r) Collagen matrix was delivered. (s) Suturing of the flap. (t) Panoramic view at 4-month follow-up. (u and v) CBCT images. (w and x) Intraoral photograph. (y) Color coded map representing the precision of the surgery. The difference between a designed root surface and the hemisectioned root surface was presented as a color-coded image. Note that the discrepancy between the surfaces was within 0.8 mm.

within 0.8 mm. This confirms that the surgery could present more accurate and predictable outcome when a 3D-designed and printed surgical guide is utilized. By considering the root canal configuration with digital dentistry, more predictable results could be produced and an iatrogenic damage could be prevented. However, there was a limitation in this case. During the hemisection, the cervical part of the remaining tooth should be prepared more than plan for gingival attachment, and a relatively large deviation occurred in this area.

Declaration of competing interest

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

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None.

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