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READER'S FORUM

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Three-dimensional surgical accuracy between virtually planned and actual surgical movements of the maxilla in two-jaw orthognathic surgery.

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I have always wondered about the accuracy of three-dimensional (3D) analysis and 3D virtual surgery. And thank you for reporting your paper on it. I have some questions as a clinician while reading the paper.

Q1. You used specific software and described that most of the processes were automatically performed; automatic digitization of the landmarks, automatic reorientation. Do the planes and landmarks set through automation do not require additional adjustments?

Q2. When I did 3D analysis, specifying points on the surface showed low reproducibility. Low reproductivity can be a limitation when doing superimposition. During the superimposition of before surgery (T0), virtual surgical simulation (VSS), and after surgery (T1), was there any error between the reference planes or landmarks at each time point?

Q3. What if the location of the maxillary first molar is bad and difficult to designate mesiobuccal cusp tip (MBCT)? In this case, how do you merge the scanned dentition and cone-beam computed tomography (CBCT) image? And how do you determine the posterior midline of the maxilla?

Questioned by
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A1. Yes, additional adjustments are necessary for completion of automatic digitization of the landmarks and automatic reorientation.

The landmark picking process consists of two steps as follows: (1) Preliminary landmark picking step: The landmarks are automatically identified on each computed tomography (CT) image with the function of "automatic digitization of the landmarks" in the software. This automatic landmark picking is based on artificial intelligence (AI) technology, which can save a great deal of time and laborious works; and (2) Verifying step: The operator checks and adjusts the position of each landmark manually and decides the final position of each landmark including 5 landmarks for reorientation.

The reorientation of 3D-CT or CBCT images consist of the three steps as follows: (1) 5 landmarks including the nasion (N) point, right and left fronto-zygomatic (FZ) points, right porion (Po) point, and right orbitale (Or) point are set automatically registered first; (2) These points are validated and adjusted manually by an operator; and (3) The three reference planes were set up using the software: As the coronal reference plane (y-axis), the naso-fronto-zygomatic (NFZ) plane was constructed using the N point and the right and left FZ points. As the horizontal reference plane (x-axis), the right Frankfort horizontal (R-FH) plane was established using the

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right Po point and the Or point, perpendicular to the NFZ plane. Then, the mid-sagittal plane (z-axis) was constructed using the N point, perpendicular to the NFZ and R-FH planes.

A2. The T0, VSS, and T1 3D-CT images can be superimposed using the function of "automatic superimposition" in the software. Since the anterior cranial base of each stage, not landmarks of the surface, is used for superimposition with the best-fit method, reproductivity or reproducibility might not be a limitation when doing superimposition.

The landmarks, which are not supposed to be changed by orthodontic treatment and/or orthognathic surgery, will be automatically transferred to the next images in different time points without any positional changes. Therefore, the software can avoid errors in analysis after superimposition.

A3. If the maxillary first molar has metal restoration, the scatter images can be occurred, especially in CBCT. In that case, it is difficult to designate the MBCT point sometimes. However, the registration procedure is performed by algorithm as well as manual fine-tuning adjustment tool for the position of MBCT point with use of the sectional images of the dentition and the best-fit method between the adjacent areas in the dental cast and 3D-CT or CBCT images. Then, the posterior midline of the maxilla can be determined using the midpoint between the right and left MBCTs.

Replied by

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