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**TITLE: Bone and teeth segmentation for 3D reconstruction applied to dental cone beam CT image**

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**Purpose**

To improve the accuracy of bone and teeth segmentation procedures in dental cone beam computed tomography (CBCT) images, the region growing and contour propagation methods were examined. The comparison with the processing for MDCT images was also done. CBCT images having high and isotropic spatial resolution, but the noise is comparatively high due to the low exposure. The attempt to improve the MPR image quality was carried out by reducing the image noise. And the 3D region growing and contour propagation methods were examined for the volumetric data of CBCT images for the bone and teeth segmentation.

**Methods**

CBCT and MDCT examinations were taken using CB Throne (Hitachi Medical Systems, Japan) and Somatom Plus 4 (Siemens, Germany), respectively. Principal exposure parameters were as follows; I-mode, 10 cm FOV in diameter, 120 kV, 15 mA, 0.2 mm in slice thickness and 10 s exposure time (CBCT) and 120 kV, 130 effective mAs, 0.5 mm slice thickness (MDCT). Some digital filtering procedures in the three-dimension were applied for the improvement of MPR images of CBCT images. Images processed were a clinical case of Mucocele in the maxillary sinus. The three-dimensional processing and displaying software for medical images, both Amira/Avizo (ZIB Berlin, Mercury Computer Systems, USA) and OsiriX were used for 3D displaying.

The 3D region growing and contour propagation methods for 512 slices of CBCT images were examined. As usual the region growing was started at the seed point. Six neighboring voxels in 3D space was evaluated for either being extracted and integrated as the bone region or not. The extraction condition was set as the threshold value at various CT numbers. The closing procedure, the repeat of dilation and reduction was carried out. The tooth segmentation was also carried out by the contour propagation method.

**Results**

Both the 3D region growing method using six neighboring voxels in 3D space worked well for the bone and tooth segmentation in CBCT images. The processed 2D slices and 3D rendering images at two different threshold values are shown in Fig. 1. The experiment of the contour propagation method is undergoing. The CBCT image's voxels have 'CT numbers' which are proportional to bone

mineral contents of objects (Ref. 1). Several threshold CT numbers were examined for the optimization of the region growing and contour propagation. The resultant 3D image by the volume rendering were obtained as shown in Fig. 2.

**Conclusion**

For the imaging of dento-alveolar and maxillary sinus regions, the depiction of thin bone structure with the high accuracy is important. The 3D region growing method was examined for 3D visualization. The bone region on CBCT images was extracted using the 3D region growing method, but there was the limitation for the thin and fine structure depiction. The combination with the 3D filtration as pre-processing procedures will improve the quality of the bone segmentation.

**References**

1. Yamashina A, Tanimoto K, Sutthiprapaporn P and Hayakawa Y : The reliability of computed tomography (CT) values and dimensional measurements of the oropharyngeal region using cone beam CT : comparison with multidetector CT. Dentomaxillofacial Radiology, Vol.37, No.5, pp.245-251, 2008.

**Fig. 1** An original CBCT image (left) and the processed image by region growing (threshold CT value: 100 and 200, respectively)

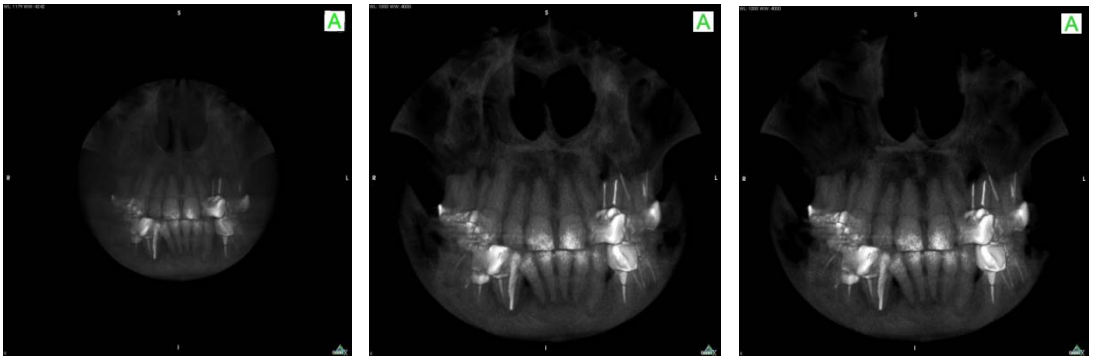

**Fig. 2** The volume rendering images on which the bone regions were extracted by the region growing method (center and right, threshold CT value: 100 and 200, respectively)