Journal of Dental Sciences (2016) 11, 170–174

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.e-jds.com

ORIGINAL ARTICLE

# Bifid mandibular canals and their cortex thicknesses: A comparison study on images obtained from cone-beam and multislice computed tomography

E-Chin Shen [a,b*], Earl Fu [a], Michelle Peng [a], Yao-Dung Hsieh [a,c], Hsiao-Pei Tu [a], Min-Wen Fu [a]

[a] *Department of Periodontology, School of Dentistry, National Defense Medical Center and Tri-Service General Hospital, Taipei City, Taiwan, ROC*
[b] *Dental Department, Taipei Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, New Taipei City, Taiwan, ROC*
[c] *Department of Dentistry, Kaohsiung Veterans General Hospital, Taiwan, ROC*

Received 28 December 2015; Final revision received 27 January 2016
Available online 29 March 2016

**KEYWORDS**
bone;
computerized tomography;
mandibular canal

**Abstract** *Background/purpose:* High prevalence of bifid mandibular canals has been visualized with various types of computerized tomography (CT). Along the canals, a various ranged corticalization was recently reported. The depiction of the fine anatomic structures on multislice and cone-beam CT images was compared.
*Material and methods:* The presence or absence of the bifid canal was assessed on 327 images obtained by multislice CT (MSCT; $n = 173$) or by cone-beam CT (CBCT; $n = 154$), according to the configuration. The cortex thickness and distribution were also assessed.
*Results:* The prevalence of bifid canal detected by CBCT was significantly greater than that detected by MSCT (42.2% vs. 18.7% for hemi-mandibles and 58.4% vs. 30.6% for patients). Cortical thickness recorded by CBCT was significantly thinner than that recorded by MSCT (0.48 mm vs. 0.65 mm, $P < 0.001$); however, the distributions of corticalization detected by the two tomography methods were similar. There was a significant association of cortex thickness with CT type and corticalization degree ($R^2 = 0.530$, $P < 0.001$).

* Corresponding author. Department of Periodontology, School of Dentistry, National Defense Medical Center and Tri-Service General Hospital, P.O. Box 90048-507, Number 161, Section 6, Minquan East Road, Taipei, Taiwan, ROC.
*E-mail address:* dentalab@tpts5.seed.net.tw (E.-C. Shen).

http://dx.doi.org/10.1016/j.jds.2016.01.002

*Conclusion:* Thinner cortices, but greater prevalence of bifid canals recorded by CBCT, compared to MSCT, suggests that clinicians should be cautious when using CT to interpret this fine anatomic structure.


## Introduction

The mandibular canal is a single bony structure with the inferior alveolar blood vessels and nerve running through the channel. However, anatomical aberrations such as bifid and trifid canals have been reported.[1–4] Nerve bundles and arteries have been observed within the bifid canals,[5,6] indicating the significance of bifid canals in the innervation and blood supply of the mandible. It is therefore important to be familiar with the anatomical details of the bifid mandibular canal to avoid neurovascular damage during surgical procedures involving the posterior mandible.[6]

A higher prevalence of bifid mandibular canals has been observed with various types of computerized tomography (CT)[7,8] and the CT images were compared to dental panoramic radiographs[2,3,9,10] because of the high-resolution and three-dimensional imaging quality of CT.[11,12] In addition, various degrees of corticalization along the bifid canals was observed on the CT images.[13] The exact role of corticalization of bifid canals is unknown; however, the presence of corticalization may have a critical role in the exploration of this area and in the identification of bifid canals because of its obvious radio-opacity. In the present study, 195 bifid mandibular canals and their corticalization were observed on multislice CT (MSCT, $n = 154$) images or cone-beam CT (CBCT, $n = 173$) images.

## Materials and methods

### Experimental design

All CT images were obtained for the needs of dental implant treatment and planning at the dental section of Taipei Tzu Chi General Hospital (New Taipei City, Taiwan) from July 2007 to September 2012. The study received the Institutional Review Board approval from, Taipei Tzu Chi Hospital. The CT images that had inadequate information or signs of previous major traumas or injuries were excluded. The CT images used and analyzed in this study were from MSCT (GE Light Speed VCT scanner; GE Healthcare, Milwaukee, WI, USA; $n = 173$) or CBCT (KaVo 3D eXam scanner; Imaging Science International LLC, Hatfield, PA 19440, USA).

For MSCT, the scan parameters were helical pitch of 0.531; gantry rotation time, 1 second; tube voltage, 120 kV; and tube current, 300 mA. At 0.625-mm intervals, 2.5-mm axial images were obtained from the level of the apex of the mandibular symphysis to the level of the mandibular angle.

For the CBCT, the scan parameters were gantry rotation time of 7 millisecond; tube voltage, 120 kV; and tube current, 5 mA. At 0.25 mm intervals, 0.25-mm axial images were obtained from the level of the apex of the mandibular symphysis to the level of the mandibular angle. A total of 327 CT images were obtained: 167 from women and 160 from men. The participants' age ranged 23–85 years with a mean age of 51 years. Parts of images selected in this study were the same images used in our previous studies.[11,13] Using a dedicated 3DX software model (Hi-Aim Plan; Hi-Aim Biomedical Technology Inc., Taipei, Taiwan, R.O.C.), the length and width of the bifid canal were identified. The degree of corticalization[13] and the thickness of the cortex were also measured (Figure 1). A total of 195 bifid canals, which included 65 from MSCT and 130 from CBCT, were examined in this study. One radiologist (MP) performed all assessments and measurements of the CT images in this study.

### Statistical analysis

The effectiveness of the CBCT and MSCT methods on determining the presence of the bifid canal was compared using the Chi-square test. The Student $t$ test was used to compare the cortex thicknesses detected by the two examining CT methods. The effect of the degree of corticalization along the bifid canals on the cortex thickness was evaluated by the regression model. The association of the cortex thickness with possible related variables (e.g., CT type, age, sex, right/left hemi-mandible, length or width of the bifid canals, cortex thickness of mandibular main canal, and degree of corticalization) was examined by multiple regression analysis. All values are presented as the mean $\pm$ the standard deviation. The null hypothesis was rejected at $P < 0.05$.

## Results

There were 195 (29.8%) bifid canals in 654 hemi-mandibles, which corresponded to a prevalence of 43.7% (i.e., 143/327 patients; Table 1). Using CBCT, the prevalence of bifid canals in 308 hemi-mandibles was 42.2%, which was significantly higher than the prevalence using MSCT (18.7% in 346 hemi-mandibles; $P < 0.001$; Table 1). A higher prevalence of a bifid canal in the patients was also observed with CBCT than with MSCT (58.4% vs. 30.6%; $P < 0.001$).

Along the bifid canals, the mean cortex thickness was 0.53 mm, and the thickness decreased when the degree of corticalization was reduced ($P = 0.02$; Table 2). Cone-beam computed tomography and MSCT were equally