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Clinical Paper
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Mandibular incisive canal in Han Chinese using cone beam computed tomography

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Abstract. The aim of this study was to provide reference information for implantology and chin bone harvesting in people of Han Chinese ethnicity by studying the mandibular incisive canal (MIC) using cone beam computed tomography (CBCT). Fifty subjects were included in the study. CBCT scans were obtained for all subjects, and 22 also underwent panoramic radiography to evaluate the visibility of the MIC. The CBCT data of the 50 subjects were reconstructed to measure MIC diameter, length, and location within the mandible. A MIC was identified in 38.6% of panoramic radiographs, with good clarity in 13.6%, while a MIC was identified in 100% of CBCT images, with good clarity in 63.6%. The diameter of the MIC decreased from origin to end. The left and right average MIC lengths were 17.84 mm and 17.73 mm, respectively. The MIC was close to the buccal cortical border and lower margin of the mandible. In conclusion, the MIC is an anatomical structure in the mandible that can be identified reliably with CBCT. On insertion, implants should be inclined slightly towards the lingual aspect of the anterior mandible to protect the MIC. The chin bone harvesting depth should be limited to 4 mm; the harvesting site can be adjusted to the region above or below the MIC.

Key words: mandibular incisive canal; anterior mandible; dental implant; bone graft; cone beam computed tomography.

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Surgery in the anterior mandibular bone region is assumed to be safe and without severe complications. Such surgeries include implant surgery, chin bone grafting, and genioplasty.[1] However, there are reports of unexplained implant failure and bleeding on implant insertion and chin bone harvesting associated with the mandibular incisive canal (MIC). Patients may experience pain, discomfort, and sensory disturbances.[2,3] The MIC was investigated as early as 1928.[4] Since then, studies have shown the MIC to be a consistent finding in cadavers.[5] Thus, it is essential to identify the MIC to prevent injury when performing implant surgery or harvesting chin bone in the anterior mandible.

Conventional radiography often fails to display the MIC, since panoramic radiographs and peri-apical radiographs are two-dimensional images. Moreover, in comparison to the mandibular canal, the MIC shows less bony cortication and the diameter is smaller.[5,6] Cone beam computed tomography (CBCT) is an excellent imaging system for oral and maxillofacial application. The advantages of CBCT include uniform magnification, the ability to produce three-dimensional (3D)

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reconstructions using software, and the high geometric accuracy, as well as low radiation doses and a relatively low cost. For the study of teeth, spongy bone, and lamina dura, the accuracy of CBCT has been judged to be equivalent to multi-slice computed tomography.[7,8]

This study was conducted to evaluate the visibility of the MIC on panoramic radiography and CBCT. The diameter, length, and location of the MIC were also assessed on CBCT to provide reference information on the anterior mandible for people of Han Chinese ethnicity.

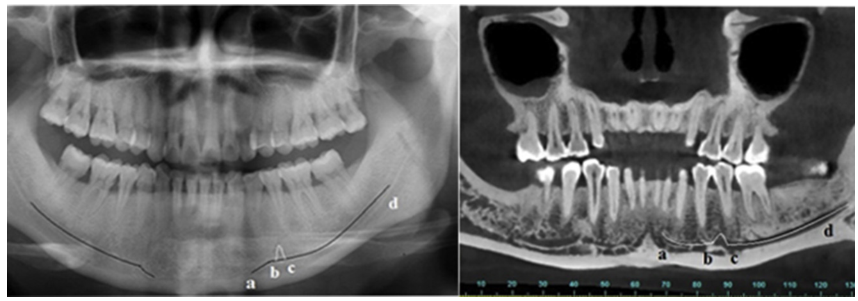

Fig. 1. Mandibular incisive canal on panoramic radiograph (left panel) and CBCT (right panel): a–b, mandibular incisive canal; b–c, mental foramen; c–d, mandibular canal.

Materials and methods

Subjects and materials

Fifty Han Chinese adults (25 men, 25 women; mean age 29.82 ± 7.00 years, range 18–42 years) were recruited between January 2011 and January 2013 at the study hospital in Nanjing, China. Consent was obtained from all subjects. This study was granted ethical approval by the medical ethics committee. Inclusion criteria were the following: subjects with all teeth present in the interforaminal region, without crowding or spacing; no untreated caries, apical diseases, tooth trauma, or periodontal diseases. The subjects had no current or past history of trauma or pathology, surgical interventions in the mandible, neurogenic disorders, or systemic diseases.

CBCT scans were obtained for all 50 of the subjects by the same professional dental technologist following a standardized protocol, with the same machine (NewTom VG 10048S; QR srl Inc., Verona, Italy), and with uniform parameter settings (110 kVp). Panoramic radiographs were also obtained for 22 of the subjects; these were taken by the same technologist following a standardized protocol, with the same panoramic radiograph unit (OP100 Orthopantomograph; Instrumentarium Imaging Corporation, Tuusula, Finland). The scanning region covered the entire skull for each subject.

The reformatted CBCT images were clear and symmetrical, and were not distorted or blurred. The panoramic radiograph (OPG) images were analyzed using ClinView software version 10.0.1.8 (Instrumentarium Imaging Corporation).

Methods

CBCT data were imported into SimPlant 11.04 software (Materialise Dental, Leuven, Belgium). Axial images were reoriented to make the occlusal plane parallel to the base plane and to ensure symmetry prior to performing the second reconstruction for each subject.[9] After creating panoramic curves, the cross-sectional views were perpendicular to the mandibular dental arch. The MIC was measured in the axial, cross-sectional, and panoramic views. A desktop personal computer was used, with an Intel-based processor and resolution of 1366 × 768 pixels (ProBook 4416s; Hewlett-Packard).

All images were investigated by an observer who was trained in the interpretation of oral and maxillofacial images and were checked by an oral and maxillofacial radiologist. Following an interval of 1 month, the CBCT DICOM data of 10 randomly selected subjects were reconstructed and the MIC re-measured to assess intra-observer reliability and repeatability.[10]

A three-point rating scale was used to grade MIC visibility on the CBCT and OPG images of the 22 subjects: not visible, visible but unclear, and visible and clear (bony cortical borders were easily identified; good clarity)[11] (Fig. 1).

The positions of the origin (anterior region of the mental foramen) and end (where the MIC disappears) and the distribution of the MIC were evaluated on the CBCT images of the 50 subjects. The following measurements of the MIC were taken below the origin, second premolar, first premolar, canine, lateral incisor, central incisor, and end in the cross-sectional view (Fig. 2): vertical and horizontal diameter of the MIC; horizontal distance from the MIC to the lingual and buccal cortical borders of the mandible; and the vertical distance from the MIC to the apex of the tooth, lower margin, and alveolar crest of the mandible. The lengths of the left and right MICs were measured from the origin to the end in the panoramic view. If the MIC disappeared, it was marked as 'disappeared'. For example, if the MIC ended at the canine, measurements of the lateral incisor and central incisor were not performed and were marked as 'disappeared' instead (Fig. 2).

Statistical analysis

The χ^2 test was used to analyze MIC visibility on OPG and CBCT. The paired *t*-test, the χ^2 test, and Fisher's exact test were used to analyze intra-observer reliability and to determine the influence of

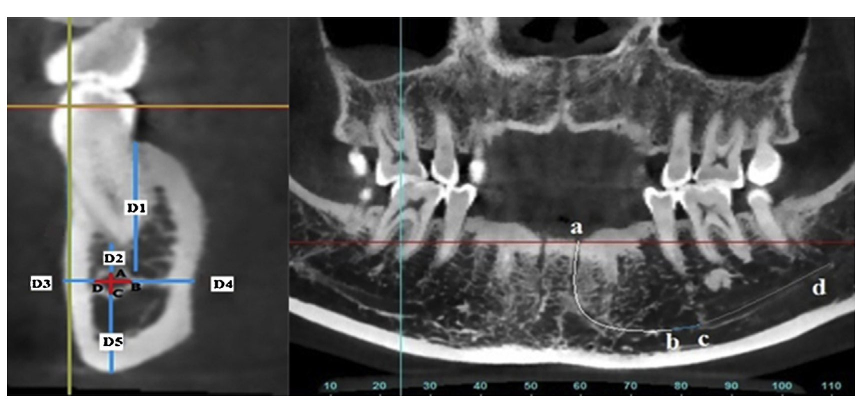

Fig. 2. Measurements of the mandibular incisive canal (MIC) in cross-sectional view and panoramic view on CBCT: A–C, vertical diameter; B–D, horizontal diameter; D1, distance from the MIC to the alveolar crest of the mandible; D2, distance from the MIC to the apex of the tooth; D3, distance from the MIC to the buccal cortical border of the mandible; D4, distance from the MIC to the lingual cortical border of the mandible; D5, distance from the MIC to the lower margin of mandible; ab, length of the MIC (length of curve).

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