Journal of the Formosan Medical Association (2016) 115, 981–990

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ORIGINAL ARTICLE

Anatomical position of the mandibular canal in relation to the buccal cortical bone in Chinese patients with different dentofacial relationships

Chun-Yuan Huang [a,b], **Yu-Fang Liao** [c,d,*]

[a] *Division of Plastic Surgery, Department of Surgery, Wan Fang Hospital, Taipei Medical University, Taipei, Taiwan*
[b] *Department of Surgery, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan*
[c] *Department of Craniofacial Orthodontics, Chang Gung Memorial Hospital, Taoyuan, Taipei, Taiwan*
[d] *Graduate Institute of Dental and Craniofacial Science, College of Medicine, Chang Gung University, Taoyuan, Taiwan*

Received 30 June 2015; received in revised form 25 September 2015; accepted 5 October 2015

KEYWORDS
inferior alveolar nerve;
mandibular canal;
prognathism;
retrognathism;
sagittal split ramus osteotomy

Background/purpose: The purpose of this study was to determine the position of the mandibular canal in relation to the buccal cortical bone in Chinese patients with three dentofacial relationships: normal dentition, retrognathism, and prognathism.
Methods: Cone-beam computed tomography and lateral cephalograms of patients with normal dentation, retrognathism, and prognathism ($n = 32$ each group) were reviewed. Measurements of the shortest distance from the outer/buccal edge of the mandibular canal to the inner surface of the buccal cortex, and the distance from the lingula of the ramus to the dorsal root of the first molar were recorded.
Results: No significant difference was observed between the three groups in the distribution of contact or fusion of the mandibular canal, or in the course of the mandibular canal on the right or left side. When the shortest distance at the lingula on the left side was >2.1 mm, no instances of contact or fusion were observed. On the right side, 100% of the patients had no contact or fusion when the shortest distance was >2.7 mm at the lingula.

Conflicts of interest: All contributing authors declare no conflicts of interest.

* Corresponding author. Department of Craniofacial Orthodontics, Chang Gung Memorial Hospital, No.123, Dinghu Rd., Guishan Township, Taoyuan County, Taipei, Taiwan (R.O.C.); College of Medicine, Chang Gung University, No.259, Wenhua 1st Rd., Guishan Dist., Taoyuan City 33302, Taiwan (R.O.C.).
E-mail address: yfliao0125@yahoo.co.uk (Y.-F. Liao).

http://dx.doi.org/10.1016/j.jfma.2015.10.004

Conclusion: The shortest distance from the outer/buccal edge of the mandibular canal to the inner surface of the buccal cortex measured at the lingula can predict contact or fusion. During sagittal split ramus osteotomy, great care should be observed at the point halfway between the lingula and the anterior ramus border where the inferior alveolar nerve is the closest to the cortical bone.

Introduction

Sagittal split ramus osteotomy (SSRO) is a common operation used to correct mandibular deformities such as prognathism, retrognathism, and asymmetry.[1] The procedure can result in good functional and cosmetic outcomes; however, neurosensory disturbance of the inferior alveolar nerve (IAN) is common with an incidence of 9—85%.[2,3] Sensory alteration in the IAN that is confirmed with neurosensory testing after SSRO ranges postoperatively from 54% to 86% at 4—8 days, 41% to 75% at 1 month, 33% to 66% at 3 months, 17% to 58% at 6 months, and 15% to 33% at 1 year.[4]

Injury to the IAN during SSRO can occur because of nerve laceration during cortical bone dissection, the nerve may be torn during splitting, or the nerve may be damaged by interosseous fixation.[1,5] Unfavorable fractures during SSRO and contact between the mandibular canal and the external cortical bone are the primary causes of IAN injury.[6,7] Unfavorable fractures occur mostly because of fusion of the medial and lateral cortical plates with no cancellous bone in between.[6,7] The incidence of unfavorable fractures is as high as 50%, and complete transection of the IAN can occur.[8—11] Yamamoto et al.[12] showed that the mandibular canal was in contact with the external cortical bone on 10 (25%) sides, and that neurosensory disturbance occurred on all sides with an incidence significantly greater than the 20% incidence of the 30 (75%) sides without contact between the canal and external cortical bone.

Anatomical variations of the IAN are therefore important to the clinician. The mandibular canal courses lingually to the roots of the second and third molars, adjacent to the roots of the first molar, and laterally to the roots of the premolars.[13] In the area of the mandibular foramen, the IAN occupies nearly the entire cancellous space between the lingual and buccal cortical plates while maintaining a close relation to the lingual plate and, as it approaches the mental foramen the mandibular canal, it turns sharply medially to laterally towards the foramen.[14] Tsuji et al[15] detected 16 of 70 skeletal class III rami having contact or fusion of the mandibular canal; in many patients, it extends from the mandibular foramen to the mandibular angle.

Performing computed tomography (CT) before surgery is useful to obtain the location of the mandibular canal, and to determine the distribution of the mandibular ramus cancellous bone. The use of cone-beam CT (CBCT) in dentomaxillofacial imaging has several advantages over conventional CT such as x-ray beam collimation, reduced effective radiation dose, and fewer artifacts.[16] It also has high accuracy and reproducibility.[17—20]

To date, the course of the IAN canal has not been compared in the three classes of dentofacial relationships (i.e., normal dentition, retrognathism, and prognathism). Thus, the purpose of this study was to determine the anatomical position of the mandibular canal in relation to the buccal cortical bone in Chinese patients with the three different classes of dentofacial relationships using CBCT records to provide information on the relative distance of the IAN to the bone cuts performed during SSRO. This information may help avoid injury to the IAN during SSRO.

Materials and methods

This study was approved by the Institutional Reviewer Board of our hospital. The requirement for informed patient consent was waived because of the retrospective nature of this study. The medical records of patients with Class I, II, and III dentofacial relationships who received CBCT scans and lateral cephalograms from 2008 to 2010 were retrospectively reviewed. The collection was stopped when the target number of patients was reached (i.e., 16 male patients and 16 female patients in each group). Inclusion criteria were men and women who were aged 18—45 years old. Exclusion criteria were pathology in the mandible (e.g., cysts, tumors), a history or evidence of previous surgery of the mandible and cleft lip/palate, and obvious asymmetry of the mandible. Patients with no first and second molars were also excluded because this would influence teeth orientation.

Dentofacial skeletal patterns were determined by lateral cephalogram (Figure 1A). Class I (i.e., normal anteroposterior relationship of the mandible to the maxilla) was defined as a point A-nasion—point B (ANB) angle of 0—4°. Class II (i.e., retrognathism; posterior relationship of the mandible to the maxilla) was defined as an ANB angle $>4°$. Class III (i.e., prognathism; anterior relationship of the mandible to the maxilla) was defined as an ANB angle $<0°$.

The CBCT scans were examined using iCAT Vision 1.62 software (Imaging Sciences International, Hatfield, PA, USA) with a voxel size of 0.4 mm $\times$ 0.4 mm $\times$ 0.4 mm. The software allows multiplanar reconstruction of the axial three-dimensional (3D) image dataset into appropriate planes for measurements. Before the measurement, the three planes were oriented. In the coronal view, the sagittal plane was adjusted so that it bisected the skull. The axial plane was adjusted parallel to the occlusal plane of the mandibular posterior teeth on both sides in the