The location of the mandibular canal in prognathic patients compared to subjects with normal occlusion

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ABSTRACT

Purpose : The purpose of this study was to compare the location of the mandibular canal in Class III malocclusion to its location in normal occlusion for adults.

Materials and Methods : For this study 32 skeletal Class III patients and 26 normal patients were observed. Four measurements were taken on cross sectional tomography between the first and second molars: the distance from the mandibular canal to the inner surface of both the buccal and lingual cortices, the distance from the mandibular canal to the inferior border of the mandible, and the buccolingual width of the mandible. The buccolingual location of the canals was classified as lingual, central, or buccal. Each measurement was analyzed with an independent *t* test to compare Class III malocclusion to normal occlusion.

Results : Compared to the control group, the prognathic group had a shorter distance from the canal to the inner surface of the lingual cortex and to the base of the mandible. A higher percentage of the canals were located lingually in the prognathic group.

Conclusion : This study showed that the mandibular canal was located more lingually and inferiorly in prognathic patients than in patients with normal occlusion. These results could help surgeons to reduce injuries to the inferior alveolar nerve. (***Korean J Oral Maxillofac Radiol 2007; 37 : 217-20***)

KEY WORDS : Mandible; Mandibular Nerve; Prognathism; Tomography

Introduction

Because of the position and course of the mandibular canal, the inferior alveolar nerve is at great risk of injury during surgery. Iatrogenic injury to the inferior alveolar nerve during the performance of surgical procedures was also reported.[1-5] To reduce injuries to the inferior alveolar nerve during surgery, knowledge of the anatomic location and course of the mandibular canal is imperative.[6]

The normal anatomy of the mandibular canal was examined[7-10] and attempts were made to determine its buccolingual location through cadaver and X-ray studies.[8,11,12] However, comparison of location of the mandibular canal between normal occlusion and malocclusion has rarely been documented.

Radiological examinations such as conventional tomography[13] and computed tomography (CT)[6] are widely used as nondestructive methods to localize the mandibular canal. The mandibular canal is more visible on CT images than on those of the other imaging techniques. Yamamoto et al.[14] used preoperative transaxial CT scanning to determine the location of the mandibular canal in the ramus of the mandible with jaw deformities and evaluated the relationship between postoperative neurosensory disturbance and distance between the mandibular canal and the external cortex. CT techniques, however, have the disadvantages of involving high radiation doses[15] and metal artifacts. Conventional spiral tomography is a sufficiently reliable imaging technique for localizing the mandibular canal.[12] Conventional tomography is an economical method and carries lower biological risks than CT because it can be limited to the potential surgical site.[16]

We assumed the hypothesis that prognathic patients' mandibular canal is located differently from that of people with normal occlusion. The purposes of this study were to compare the location of the mandibular canal in the prognathic population to that in the normal population, and to provide information that will help surgeons to avoid injuries to the inferior alveolar nerve during surgery.

*This study was supported by a grant of Pusan National University Hospital.

Received September 5, 2007; accepted October 26, 2007

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Fig. 1. Cross-sectional tomography of the area from the first to second molars.

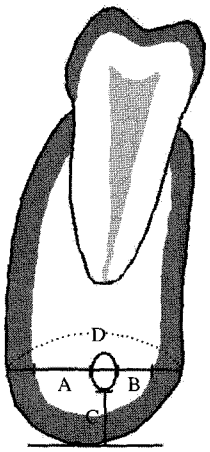

Fig. 2. The measurements taken during the study. A. Distance from the canal to the inner surface of the buccal cortex, B. Distance from the canal to the inner surface of the lingual cortex, C. Distance from the canal to the inferior border of the mandible, D. Buccolingual width of the mandible.

Materials and Methods

Subjects for this study consisted of 32 skeletal Class III patients (12 males and 20 females) scheduled for bilateral sagittal split osteotomy, and 26 adults (13 males and 13 females) with normal occlusion who underwent a tomography unilaterally for implant placement. The group's age ranged from 20 to 31 years (mean age, 22 years) and from 22 to 64 years (mean age, 46 years), respectively.

Cross-sectional tomography of the area from the first to second molars was undertaken using a Scanora X-ray unit (Orion Corp., Soredex, Helsinki, Finland). The Scanora imaging mode used was spiral tomography to obtain 4mm slice thickness and four consecutive slices (Fig. 1). Patients' lower mandibular border was kept parallel to the floor during exposure. The exposure values were 66-70kV and 3mA. Radiographic exposures were recorded on Ortho CP-G Plus film (Agfa Co., Mortsel, Belgium) using Kodak Lanex fine intensifying screens (Eastman Kodak Co., Rochester, NY, USA). Film was processed using an FPM 3500 X-ray film processor (Fuji Co., Ltd., Tokyo, Japan).

Tomograms were examined by two viewers who had advanced training in oral and maxillofacial radiology. The mandibular canal was traced on the area between the first and second molars on the tomogram. When the mandibular canal was visible bilaterally, the measurements were taken bilaterally; when only one canal was visible, the measurements were taken only on that side. The 32 Class III patients and the 26 control patients had a total of 43 (19 right and 24 left) and 26 available sites, respectively.

Four measurements were taken from the area between the first and second molars on the tomograms (Fig. 2). The following distances were measured: between the buccal side of the mandibular canal and the inner surface of the buccal cortex, between the lingual side of the mandibular canal and the inner surface of the lingual cortex, between the inferior border of the mandibular canal and the base of the mandible, and the buccolingual width of the mandible. Radiographic measurements were taken by two viewers with advanced training in oral and maxillofacial radiology and interobserver reproducibility was assessed. To determine intraobserver reproducibility, one observer repeated the measurements twice at an interval of four weeks. The measurements were made to the nearest 0.1 mm with a caliper. They were corrected for magnification, which was 1.7 × for the tomographic image. The buccolingual location of the canals was defined as lingual, central, or buccal according to Hallikaine's methsod.[17]

The intra- and interobserver reproducibility of the measurements on the radiographs was assessed using coefficients of variation:[18] they were 1.357% for intraobserver reproducibility and 1.863% for interobserver reproducibility. Differences between right and left were tested with a paired *t* test for 15 paired sides in the prognathic group. Differences between groups were examined for statistical significance based on independ-

Table 1. Comparison of measurements between the normal and prognathic groups (mm)

	Normal (n=26)	Prognathic (n=43)	*P*
	Mean±SD	Mean±SD	
Distance from the canal to the inner surface of the buccal cortex	2.73±1.14	2.70±0.93	0.898
Distance from the canal to the inner surface of the lingual cortex	1.58±1.02	0.97±0.61	0.003*
Distance from the canal to the inferior border of the mandible	8.31±1.55	7.27±1.58	0.009*
Buccolingual width of the mandible	11.10±2.21	10.24±1.1	0.073

*t test, $P<0.01$

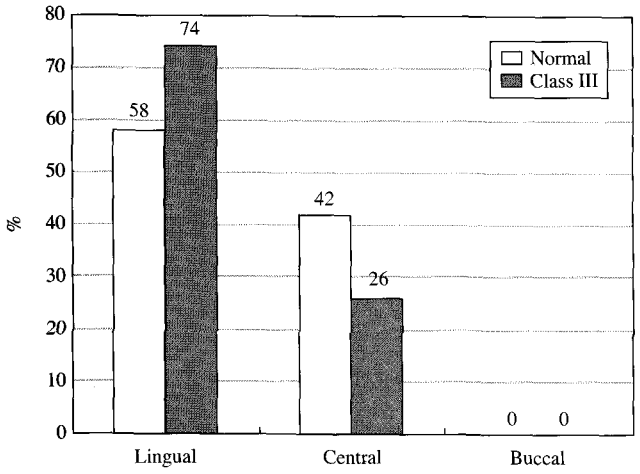

Fig. 3. Comparison of the location of the mandibular canal between the normal and prognathic groups.

ent t tests. A P value less than 0.05 was considered a statistically significant difference. All of the analyses were carried out with SPSS version 12 (SPSS Inc, Chicago, IL, USA).

Results

The paired t test showed no statistically significant right-to-left variation in any measure. Therefore, the values of both the right and left sides for each measurement were combined and treated as a single group. When comparing differences in these measurements by gender, there was a significant difference only in the buccolingual width of the mandible: it was thinner in females in both groups.

The distance between the canal and the lingual border in prognathic mandibles was shorter than in normal group ($P<0.01$). The distance from the canal to the inferior border of the mandible was shorter in prognathic patients ($P<0.01$). The mandibular canal is located approximately 1mm more inferiorly on the mandibular body in prognathic patients than in the normal controls (Table 1).

Sixty-eight percent were located lingually, no canal was located buccally, and 32% were located centrally. A higer percentage of the canals were located lingually in the prognathic group than in the control group (Fig. 3).

Discussion

Information on the location of the mandibular canal is useful for planning surgeries such as implants[15,19,20] or sagittal split osteotomy.[6,14,16,21,22] The position of mandibular canal before sagittal split osteotomy has rarely been discussed, although the importance of the canal's location has been recognized.[3,21]

Hallikainen et al.[17] reported that the buccolingual width of the retrognathic mandibles was significantly thicker than that of the prognathic mandibles. The results of present study show that the buccolingual width of the prognathic group was thinner than in the normal occlusion, although the difference was insigificant. During surgical planning we should consider the fact that the buccolingual width might be thinner in patients with Class III malocclusion. Therefore, it is particularly necessary to plan surgeries cautiously for patients with a thin mandibular body.

Kane et al.[5] reported that the mean distance between the mental foramen and inferior border was shorter in prognathic patients than in retrognathic patients.[17] In our study, the mean distance from the mandibular canal to the inferior border of the mandible was shorter in the prognathic group than in the control group, consistent with our expectations.

On average, the mandibular canals were situated lingually, as observed in previous studies.[12,16] Hallikainen et al.[17] found a significantly greater incidence of lingual location of the canal in retrognathic mandibles than in prognathic mandibles. Before this study, we were afraid of finding the mandibular canal in a buccal position in the prognathic group. Contrary to our expectation, however, no mandibular canal was not observed in a buccal position. The results of this study showed a more lingual position of the canal in prognathic patients than in the normal group.

It is probably reasonable for a surgeon to assume that the location of the mandibular canal of a prognathic patient differs from that of normal patients.[5] Locating the mandibular canal

in the molar region of the mandible is important to prevent injuries to the inferior alveolar nerve during surgery. This study shows that the mandibular canal was located more lingually and inferiorly in prognathic patients than in subjects with normal occlusion. Special care is required for patients with a thin mandible before sagittal split osteotomy.

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