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# Topographic anatomy of mandibular canal in Korean

朝鮮大學校 大學院

齒醫學科

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한국인 턱뼈관의 국소해부

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# Topographic anatomy of mandibular canal in Korean

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## ABSTRACT

### Topographic anatomy of mandibular canal in Korean

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For certain placement of dental implant in the mandible, a proficient knowledge of anatomy and an accurate localization of the mandibular canal are extremely important to avoid interference with the neurovascular bundle. The purpose of this study was to investigate the dimension, the horizontal and vertical location of the mandibular canal in Korean.

Eighteen dentulous hemimandibles were selected for this study. Distal surfaces of the second molar (group 1), first molar (group 2), second premolar (group 3) and first premolar (group 4) were sectioned and then imaged with a scanner, perpendicular to the lower border of the mandible, and then each mandibular canal was drawn as rotundity. For each section, after setting the vertical axis of teeth, measurements were carried out as follows; mandibular canal diameter; distance from the buccal external border to the buccal side of the mandibular canal; distance from the lingual external border to the lingual

side of the mandibular canal; distance from the upper border of the alveolar crest to the upper border of the mandibular canal; distance from the lower border of the mandibular canal to the mandibular inferior border. The results are as follows;

1. The average diameter of the mandibular canal was the greatest with a mean of 2.31 mm in group 1 and then slightly decreased, in group 4, the canal diameter was 1.87 mm.
2. The distance from the buccal border to the buccal side of the mandibular canal gradually decreased from group 1 to group 4. Conversely, the distance from the lingual side of the mandibular canal to the lingual border gently increased from group 1 to group 4.
3. The distance from the upper border of the alveolar crest to the upper border of the canal increased from group 1 to group 4. The distance from the lower border of the mandibular canal to the mandibular inferior border showed similar pattern in each group with a mean of 10 mm.

To avoid complication of sensory paralyses during implant surgery in the mandibular canal region, a thorough understanding of anatomy and a careful planning are demanded. These results could be able to provide anatomic information for clinical applications.

## I. INTRODUCTION

Recently, implant is very popular with patients, so a proficient knowledge of oral anatomy is needed to provide accurate dental implant surgery for patients.

The mandibular canal is one of the most investigated structures by panoramic radiography, conventional (cross-sectional) tomography, computerized tomography (Peker et al., 2008), and magnetic resonance imaging (Ikeda et al., 1996) in implant dentistry because untoward sequelae frequently occurs to damage the inferior alveolar nerve which is the major configuration of the mandibular canal.

The mandibular nerve that a branch of the fifth cranial nerve (Kim, 2005), gives rise to the inferior alveolar nerve and it enters the mandibular canal on the medial surface of the ramus by the lingula (Greenstein et al., 2008). The mandibular canal contains the inferior alveolar nerve, artery and loose connective tissue (Ikeda et al., 1996), usually it has cortical bone around it (Greenstein et al., 2008).

The greater diameter of the canal averages 4.1 mm near the mandibular foramen and the average diameter of the canal is 3.4 mm in the middle of the canal (Ikeda et al., 1996). The mandibular canal is usually situated centrally in the mandibular corpus, slightly closer to the lingual cortex in its distal parts; towards the front, it approaches the vestibular cortical layer (Obradovic et al., 1995). The inferior alveolar nerve crosses from the lingual to the buccal side of the mandible, it is often located midway between the buccal and lingual cortical plates of bone in the first molar (Miller et al., 1990).

Distances from the alveolar crest to the mandibular canal, overall bone height and bone width were measured using spiral tomography (Bou Serhal et al.,

2001). It was reported that the upper border of the mandibular canal is located 3.5 to 5.4 mm below the root apices of first and second molars (Littner et al., 1986). In the other case, the canal was often close to the inferior border of the mandible, and it was also possible for the mandibular canal to be adjacent to the apex of the mandibular molar (Saralaya et al., 2005). In the body of the mandible, the neurovascular bundle was located about one centimeter above the mandibular inferior border (Gowgiel, 1992).

The intrabony course of the inferior alveolar nerve in the mandibular canal of the edentulous mandible region was investigated (Kieser et al., 2004) and arrangement of the neurovascular bundle within the mandibular canal was established (Wadu et al., 1997).

Although kinds of radiological technology have been used to study the mandibular canal in foreigners, there were few studies to investigate the mandibular canal using actual measurement in Korean.

Therefore, the purpose of this study was to investigate the dimension, the horizontal and vertical location of the mandibular canal in Korean to provide anatomical information in order to avoid interference with the neurovascular bundle during implant surgery in the mandibular canal region.

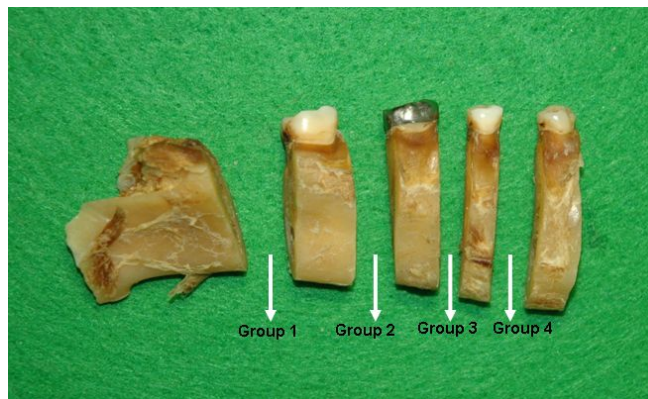
## II. MATERIALS AND METHODS

### 1. Materials

Eighteen hemimandibles of fifteen cadavers (10 men and 5 women; mean age, 53.3, aged between 41 and 84 years) who had donated their bodies for research to Chosun University school of medicine were selected for this study. All of the segments were without the third molar and completely dentulous.

### 2. Sample processing

In order to obtain the position of the mandibular canal, these mandibles were sectioned between the rest posterior portion of the mandibular body and the second molar (group 1), the second molar and the first molar (group 2), the first molar and the second premolar (group 3), the second premolar and the first premolar (group 4) following the long axis of the teeth (Fig. 1).



**Fig. 1.** Mandibular sectioning at the 4 sites. Each section was as perpendicular as possible to the lower border of mandible.

Distal surfaces of the second molar, first molar, second premolar, first premolar vertical sections were imaged using a scanner (HP scanjet, Hewlett Packard, Houston, TX, USA), perpendicular to the lower border of the mandible, and then each mandibular canal was drawn as rotundity with Adobe Photoshop CS3 (Adobe, Sanjose, CA, USA) (Fig. 2).



**Fig. 2.** Image scan and rotundity marking at the mandibular canal.

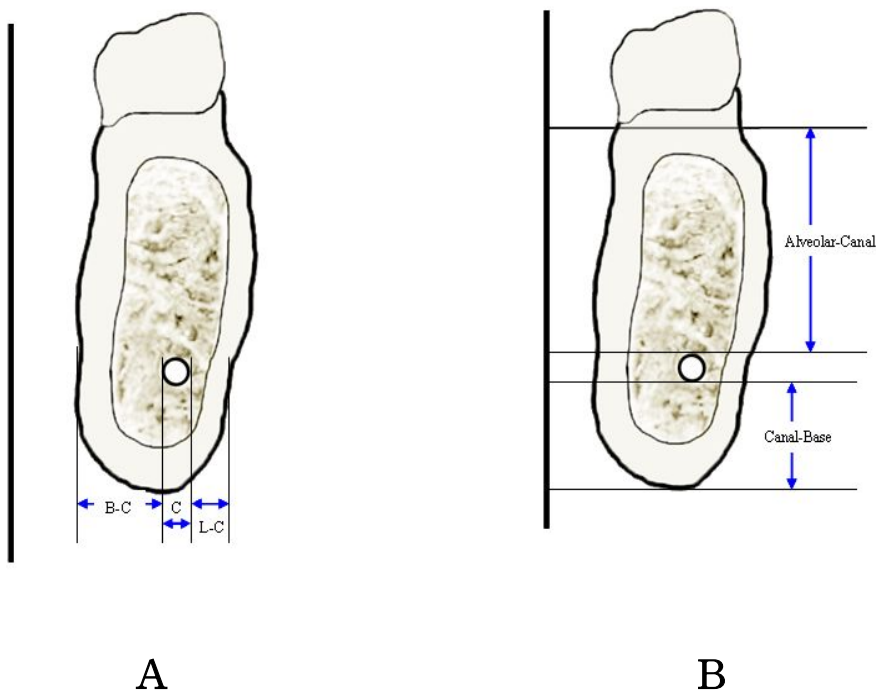
### 3. Measurement

For each section, after setting the vertical axis of teeth, measurement was also carried out with Adobe Photoshop CS3 (Adobe, Sanjose, CA, USA) (Fig. 3).

Measuring points were as follows;

- 1) Mandibular canal diameter

- 2) Distance from the buccal external border to the buccal side of the mandibular canal (Buccal-Canal)
- 3) Distance from the lingual external border to the lingual side of the mandibular canal (Lingual-Canal)
- 4) Distance from the upper border of the alveolar crest to the upper border of the mandibular canal (Alveolar-Canal)
- 5) Distance from the lower border of the mandibular canal to the mandibular inferior border (Canal-Base).



**Fig. 3.** Measurement of the dimension, the horizontal (A) and vertical (B) location of the mandibular canal on the distal surface of the posterior teeth.



### III. RESULTS

#### 1. Mandibular canal diameter

The average diameter of the mandibular canal was the greatest with a mean of 2.31 mm in group 1 and then slightly decreased, in group 4, the canal diameter was 1.87 mm (Table 1).

**Table 1.** Diameter of the mandibular canal on the distal surface of the posterior teeth (mm)

Group	Canal Diameter	
	Mean	SD
Group 1	2.31	0.23
Group 2	2.21	0.19
Group 3	1.99	0.17
Group 4	1.87	0.15

#### 2. Distances from the buccal external border to the buccal side of the mandibular canal and from the lingual external border to the lingual side of the mandibular canal

In group 1, the distance from the buccal border to the buccal side of the mandibular canal was the farthest with a mean of 8.41 mm, and then gradually decreased with a mean of 3.83 mm in group 4. Conversely, The distance from

the lingual side of the mandibular canal to the lingual border was the closest with a mean of 3.11 mm in group 1 and then gently farther and farther to 6.07 mm in group 4. In group 3, distances from the buccal border to the buccal side of the mandibular canal and the lingual border to the lingual side of the mandibular canal showed almost similar value with means of 4.69 and 5.39 mm (Table 2).

**Table 2.** Distances of Buccal-Canal and Lingual-Canal on the distal surface of the posterior teeth (mm)

Group	Buccal-Canal		Lingual-Canal	
	Mean	SD	Mean	SD
Group 1	8.41	1.12	3.11	1.07
Group 2	7.32	1.08	3.52	0.98
Group 3	4.69	1.57	5.39	1.38
Group 4	3.83	1.62	6.07	1.08

### 3. Distances from the upper border of the alveolar crest to the upper border of the mandibular canal and from the lower border of the mandibular canal to the mandibular inferior border

The distance from the upper border of the alveolar crest to the upper border of the canal was 16.44 mm in group 1, and gradually increased to 22.82 mm in group 4. The distance from the lower border of the mandibular canal to the

mandibular inferior border showed similar value in each section with a mean of 10 mm (Table 3).

**Table 3.** Distances of Alveolar-Canal and Canal-Base on the distal surface of the posterior teeth (mm)

Group	Alveolar-Canal		Canal-Base	
	Mean	SD	Mean	SD
Group 1	16.44	2.39	10.69	1.96
Group 2	19.39	1.76	9.76	1.16
Group 3	21.53	2.06	10.75	1.26
Group 4	22.82	2.41	10.67	1.76

## IV. DISCUSSION

The major sequelae in the posterior portion of the mandible is sensory paralyses in implant dentistry by reason of penetrating into the inferior alveolar nerve in the mandibular canal inadvertently. Hence, to avoid interference with the neurovascular bundle during implant surgery, the location of the mandibular canal needs to be verified before placement of implants. The dimension, the horizontal and vertical location of the mandibular canal were investigated in our study.

In this study, the greatest diameter in group 1 was 2.31 mm, and then slightly decreased to 1.87 mm in group 4. Ikeda K et al. (1996) reported that the greater diameter of the canal averaged 4.1 mm near the mandibular foramen, and the average diameter of the canal was 3.4 mm in the middle of the canal. In their study, the mandible was removed within 48 hours of death, and then they used multiplanar magnetic resonance image to study the mandibular canal. However, in our study, the mandible was not as fresh as they used, so the possibility of cadaveric contraction could not be ignored.

The farthest distance from the buccal border to the buccal side of the mandibular canal was 8.41 mm in group 1, and gradually decreased from group 1 to group 4. Conversely, the distance from the lingual border to the lingual side of the mandibular canal gently increased with a mean of 3.11 mm to 6.07 mm from group 1 to group 4. The results demonstrated that the mandibular canal was situated more lingually in the molar region, by the second premolar, it was located almost midway between the buccal and lingual cortical plate, towards the front it, it approached the buccal cortical plate. Gowgiel(1992) reported that the distance from the lateral border of the neurovascular bundle

to the external surface of the buccal plate was usually half a centimeter in the molar and premolar regions. Miller CS et al. (1990) reported that the inferior alveolar nerve crossed from the lingual to the buccal side of the mandible and often, it was located midway between the buccal and lingual cortical plates of bone by the first molar. Differences of these results may be related to race.

Denio et al. (1992) evaluated cadavers to determine distances from the inferior alveolar nerve to the apices of mandibular posterior teeth: the mean distance was 3.7, 6.9, and 4.7 mm in the second molar, first molar and premolars. Similarly, Littner et al. (1986) reported the upper border of the mandibular canal was located 3.5 to 5.4 mm below the root apices of first and second molars. Unfortunately, few studies have verified to determine the distance from the upper border of the alveolar crest to the upper border of the mandibular canal except Bou Serhal et al. (2001) studied. In this study, mean distances from the upper border of the alveolar crest to the upper border of the mandibular canal were 16.44, 19.39, 21.53, and 22.82 mm in group 1, group 2, group 3, and group 4. These results may provide anatomic information when proceeding implant surgery at the same time of the teeth extraction.

The distance from the lower border of the mandibular canal to the mandibular inferior border in the distal surface of posterior teeth was also studied in this research. It showed similar value in each section with a mean of 10 mm, which was the same result as Gowgiel(1992) reported.

To avoid complication of sensory paralyses during implant surgery in the mandibular canal region, a thorough understanding of anatomy and a careful planning are demanded. These results could be able to provide anatomic information for clinical applications.

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## ABSTRACT in KOREAN

### 한국인 턱뼈관의 국소해부 정 령 령

조선대학교 대학원 치의학과  
(지도교수 : 김 홍 중)

아래턱의 임플란트 식립에 있어서 턱뼈관의 해부학적 지식과 정확한 위치결정은 신경혈관다발 손상을 피하는데 있어서 아주 중요하다. 본 연구에서는 해부학적 계측을 통해 한국인 턱뼈관의 직경과 수직 및 수평적 위치를 알아내고자 한다.

조선대학교 의과대학의 해부학 연구용 시신 15구의 아래턱뼈 18쪽을 사용하였으며 둘째 큰어금니(제1군), 첫째 큰어금니(제2군), 둘째 작은어금니(제3군), 첫째 작은어금니(제4군)의 먼쪽면을 치아의 장축에 따라 절단한 후, 스캐너로 스캔한 다음 각 절편의 턱뼈관에 원형을 그리고 포토샵을 이용하여 턱뼈관의 직경, 볼쪽과 혀쪽에서 턱뼈관까지의 거리, 이틀능선과 아래턱의 아래모서리에서 턱뼈관까지의 거리를 측정하였다.

턱뼈관의 직경은 제1군에서 2.31mm로 제일 컸으며 앞으로 갈수록 감소하여 제4군에서는 1.87mm를 보였다. 볼쪽에서 턱뼈관까지의 거리는 제1군에서 제4군으로 갈수록 점차 감소하는 반면, 혀쪽에서 턱뼈관까지의 거리는 제1군에서 제4군으로 갈수록 점차 증가하였다. 이틀능선에서 턱뼈관까지의 거리는 제1군에서 제4군으로 갈수록 점차 증가하였으며, 턱뼈관에서 아래턱의 아래모서리까지의 거리는 네 군 모두 10mm 안팎으로 거의 비슷하였다.



아래턱의 턱뼈관 부위에서 임플란트 시술을 시행하기 전 신경혈관다발의 손상을 피하기 위해서는 철저한 해부학적 지식과 주의 깊은 치료계획이 요구된다. 위의 결과들은 아래턱 어금니 부위의 임상적 응용에서 유용한 해부학적 정보를 제공할 것으로 사료된다.

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비록 같은 민족이라 하지만 살아온 환경, 생활습관과 문화적 차이도 있었고, 중국에서 치의학학을 배웠지만 교육방식에도 많은 차이가 있어서 처음엔 진짜 앞이 막막하였습니다.

제가 이런 두려움을 극복하고 용기를 내어 2년 동안의 석사공부를 원만히 끝낼 수 있게끔 저를 받아주시고 아낌없이 베풀어주시고 배려해주신 김홍중 교수님께 우선 진심어린 감사를 드리고 또 많이 부족한 저를 옆에서 지켜봐주시고 격려해주신 생리학교실 김도경 교수님, 교정학교실 임성훈 교수님, 생화학교실 국중기 교수님, 김춘성 교수님, 의과대학 해부학교실 정윤영 교수님, 저랑 같이 2년을 생활하면서 저한테 많은 도움을 주신 이명화 선생님, 치과대학을 졸업하고 우리 교실에 남은 유선경 선생님, 생리학교실 김수영 선생님, 조선훈 선생님, 조직학교실 최백동 선생님, 왕관림 선생, 비록 지금 같이 있지 않지만 인사드리고 싶은 박종태 선생님, 박명화 선생님 모든 사람들에게 감사드립니다.

오천만명 되는 한국인에서 여러분을 만난 것은 그 만큼한 인연이 있었기 때문이 아닐까 싶습니다. 소중한 인연 잘 간직하고 저에게 나눠주신 열매를 알뜰히 챙겨서 이후 저의 더 큰 삶의 열매를 위해 가치 있게 활용하고 익혀가겠습니다.

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논문제목	한글 : 한국인 턱뼈관의 국소해부 영어 : Topographic anatomy of mandibular canal in Korean				
<p>본인이 저작한 위의 저작물에 대하여 다음과 같은 조건아래 조선대학교가 저작물을 이용할 수 있도록 허락하고 동의합니다.</p> <p style="text-align: center;">- 다                      음 -</p> <ol style="list-style-type: none"> <li>1. 저작물의 DB구축 및 인터넷을 포함한 정보통신망에의 공개를 위한 저작물의 복제, 기억장치에의 저장, 전송 등을 허락함</li> <li>2. 위의 목적을 위하여 필요한 범위 내에서의 편집·형식상의 변경을 허락함. 다만, 저작물의 내용변경은 금지함.</li> <li>3. 배포·전송된 저작물의 영리적 목적을 위한 복제, 저장, 전송 등은 금지함.</li> <li>4. 저작물에 대한 이용기간은 5년으로 하고, 기간종료 3개월 이내에 별도의 의사 표시가 없을 경우에는 저작물의 이용기간을 계속 연장함.</li> <li>5. 해당 저작물의 저작권을 타인에게 양도하거나 또는 출판을 허락을 하였을 경우에는 1개월 이내에 대학에 이를 통보함.</li> <li>6. 조선대학교는 저작물의 이용허락 이후 해당 저작물로 인하여 발생하는 타인에 의한 권리 침해에 대하여 일체의 법적 책임을 지지 않음</li> <li>7. 소속대학의 협정기관에 저작물의 제공 및 인터넷 등 정보통신망을 이용한 저작물의 전송·출력을 허락함.</li> </ol> <p style="text-align: center;">동의여부 : 동의( O )    반대(      )</p> <p style="text-align: center;">2009년    8월</p> <p style="text-align: center;">저작자:    정 려 령                      (서명 또는 인)</p> <p style="text-align: center;"><b>조선대학교 총장 귀하</b></p>					