Measurement of Anterior Loop Length for the Mandibular Canal and Diameter of the Mandibular Incisive Canal to Avoid Nerve Damage When Installing Endosseous Implants in the Interforaminal Region

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Purpose: To measure the anterior loop length (ALL) for the mandibular canal and diameter of the mandibular incisive canal at various points to ascertain the mesial distance from the mental foramen at which it is safe to install endosseous implants in the most distal area of the interforaminal region.

Patients and Methods: Using 38 cadavers (75 hemimandibles), the ALL and the diameter of the incisive canal at its origin and at 1 mm intervals up to 5 mm mesially from the origin were measured using operative calipers.

Results: Measured data are expressed as minimum, maximum, and mean ± standard deviation. ALL was 0.0, 6.0, and 1.5 ± 1.4 mm, the diameter of the incisive canal was 1.0, 6.6, and 3.1 ± 1.2 mm at the origin, 0.6, 5.8, and 2.6 ± 1.1 mm at 1 mm, 0.5, 5.7, and 2.2 ± 1.0 mm at 2 mm, 0.5, 6.0, and 2.0 ± 1.0 mm at 3 mm, 0.5, 5.0, and 1.8 ± 0.8 mm at 4 mm, and 0.5, 4.9, and 1.7 ± 0.8 mm at 5 mm mesially.

Conclusion: The above results showed that because there may be large variations in the ALL and the diameter of the incisive canal, one should not assume that a fixed distance mesially from the mental foramen will be safe. Intraoperative examination of vital structures is indispensable for the safe installation of implants in the interforaminal area of the mandible. Not only the ALL but also the diameter of the incisive canal should be investigated on a case-by-case basis to determine the appropriate location for each individual.

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Sensory disturbances of the mental nerve region may arise after endosseous implants (hereafter referred to as implants) are installed in the mandibular interforaminal region.[1] The causes are considered to include damage to the inferior alveolar nerve in the anterior loop of the mandibular canal anterior to the mental foramen[2] or stretching injury of the inferior alveolar nerve because a fixture placed anteriorly to the mental foramen can engage the incisive branch in the mandibular incisive canal.[3] Hence, in patients with a long anterior loop in the mandibular canal or an incisive canal with a large diameter, a sensory disturbance of the mental nerve region is likely to occur when an endosseous implant is installed in the most distal area of the interforaminal region in the absence of preoperative familiarization with this anatomic information. For this reason, several articles have reported measurements of the anterior loop length (ALL) and diameter of the incisive canal using cadavers or dry skulls.[4-11] However, the debate is not settled as to the mesial distance from the mental foramen at which drilling is safe to begin.

Therefore, the objective of this study was to measure the ALL of the mandibular canal and diameter of

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Table 1. DISTRIBUTION OF CADAVER SPECIMENS BY AGE AND SEX

Age (yr)	Male	Female	Both
48-59	3 (6)	1 (2)	4 (8)
60-69	10 (19)	1 (2)	11 (21)
70-79	6 (12)	4 (8)	10 (20)
80-93	3 (6)	10 (20)	13 (26)
All	22 (43)	16 (32)	38 (75)

NOTE. Number of hemimandibles in each group is given in parentheses.

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the incisive canal using operative calipers to ascertain the distance in the mesial direction from the mental foramen at which it is safe to install implants.

Patients and Methods

PATIENTS

Thirty-eight Japanese cadavers (75 hemimandibles, 37 right and 38 left) were examined (Table 1). The specimens had been stored in 10% neutral formalin (collection of the Department of Anatomy, Saga Medical School, Saga Japan). Twenty-two male (43 hemimandibles) and 16 female (32 hemimandibles) cadavers were used, with the age at death ranging from 48 to 93 years (mean, 74.1 years). The specimens were divided into 4 age groups for statistical analysis: 48 to 59 years (4 patients, 8 hemimandibles), 60 to 69 years (11 patients, 21 hemimandibles), 70 to 79 years (10 patients, 20 hemimandibles), and 80 to 93 years (13 patients, 26 hemimandibles). These 75 hemimandibles were further subdivided into 2 groups according to dental status: a dentate group with 1 to 5 teeth (anterior teeth or premolar teeth) (50 hemimandibles) and an edentulous group with no teeth (25 hemimandibles). The heights were unknown.

Cadavers with disorders that might have influenced the mandibular shape were excluded from the study. In each specimen, the mandible was detached from the cadaver and completely exposed.

LANDMARKS AND BASE PLANES

The inferior margin of the mandible (IMM) was defined as the inferior-most margin plane when the mandible was placed on the flat experimental table (Fig 1). A line was drawn between the right and left mental foramina (interforaminal line) parallel to the IMM (Fig 1). The midsagittal (Md) plane was defined as the plane passing through 3 points: *1*) the midpoint of the interforaminal line; *2*) the midpoint of the IMM (Gnathion; Gn); and *3*) the highest point in the center of the mental spine (Fig 1). The IMM and Md plane were regarded as base planes. In the next step, the buccal cortical and spongy bone around the mental foramina was eliminated using a steel round bar (5 mm diameter) and a sharp spoon, and the inferior alveolar and incisive neurovascular bundles within the mandibular and incisive canals were confirmed (Fig 2). Furthermore, the presence of nerves in the inferior alveolar and incisive neurovascular bundles was ascertained. The range examined was between the inferior alveolar neurovascular bundle within the mandibular canal 10 mm posterior and parallel to the IMM from the point on the posterior-most margin of the mental foramen through which the perpendicular to the IMM passes, and the incisive neurovascular bundle within the incisive canal 10 mm anteriorly and parallel to the IMM from the point on the anterior-most margin of the mental foramen through which

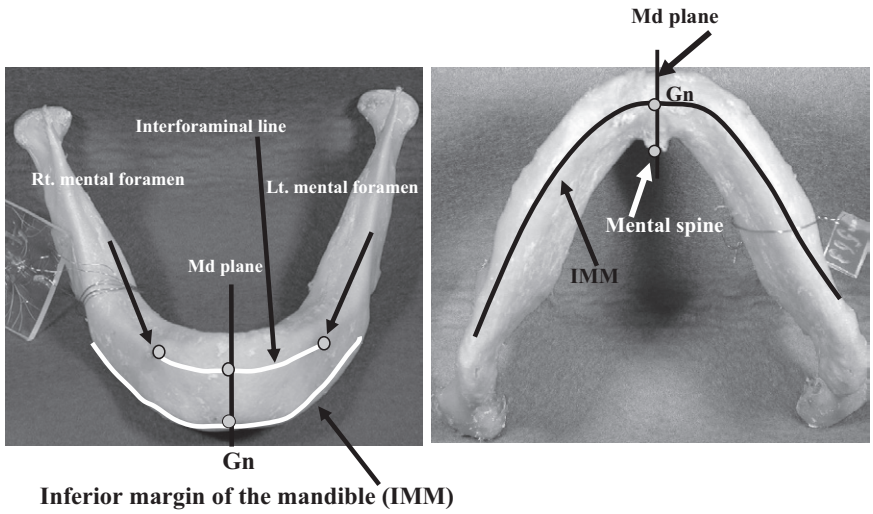

FIGURE 1. Frontal and basal view of the mandible. The inferior margin of the mandible (IMM) was defined as the inferior-most margin plane when the mandible was placed on the flat experimental table. The Gnathion (Gn) was defined as the midpoint of the IMM. A line was drawn between the right and left mental foramina (interforaminal line) parallel to the IMM. The midsagittal (Md) plane was defined as the plane passing through 3 points: 1) the midpoint of the interforaminal line, 2) Gn, and 3) the highest point in the center of the mental spine.

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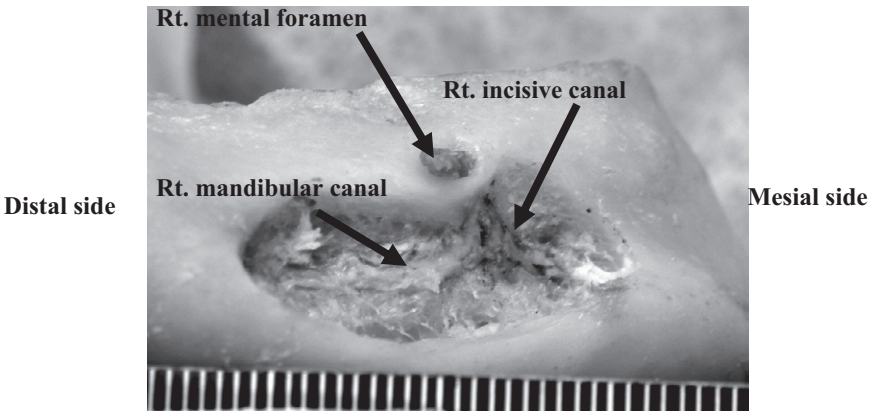

FIGURE 2. Mental region of the mandible (Rt). The buccal cortical and spongy bone around the mental foramina was eliminated using a steel round bar (5 mm diameter) and a sharp spoon, and the inferior alveolar and incisive neurovascular bundle within the mandibular and incisive canal were confirmed.

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the perpendicular to the IMM passes (Fig 3). To identify the inferior alveolar and incisive nerves, an illuminated magnifier (SKK-F-3; Otsuka Optics Corporation, Tokyo, Japan) was used.

For the purpose of the present measurements, the following planes were defined when the mandible was placed on the flat experimental table (Fig 4):

Plane A: The plane where the perpendicular to the IMM passes through the anterior-most margin of the mental foramen.

Plane B: The plane where the perpendicular to the IMM passes through the anterior-most margin of the mandibular anterior loop (coincident with the origin of the incisive canal).

Plane A and plane B were coincident in the absence of an anterior loop.

MEASUREMENTS

The following clinical measurements were selected in this research.

1) ALL (Fig 4): The ALL is the shortest straight-line distance between plane A and plane B.

2) Diameter of the incisive canal (Fig 5): The diameter of the incisive canal was measured at the origin and every 1 mm from the origin for 5 mm toward the Md plane. The diameter at the origin of the incisive canal (point 0 mm) was defined as the internal diameter of the incisive canal formed by plane B. Each diameter of the incisive canal measured at 1-mm intervals toward the Md plane was parallel to the aforementioned plane B, and was defined as the internal diameter of the incisive canal at 1-mm intervals toward the Md plane up to 5 mm mesially.

The ALL and diameter measurements were made using measuring calipers (Fig 6) (Castroviejo 18-mm angled measuring calipers; Kohler, Neuhausen, Germany) and vernier calipers (Fig 7) (N10S; Mitutoyo Corporation, Kanagawa, Japan) for surgical applications. The calipers were placed at both ends of the distance (Fig 6), locked with the adjusting screw, then the distance was marked and read off using vernier calipers (Fig 7).

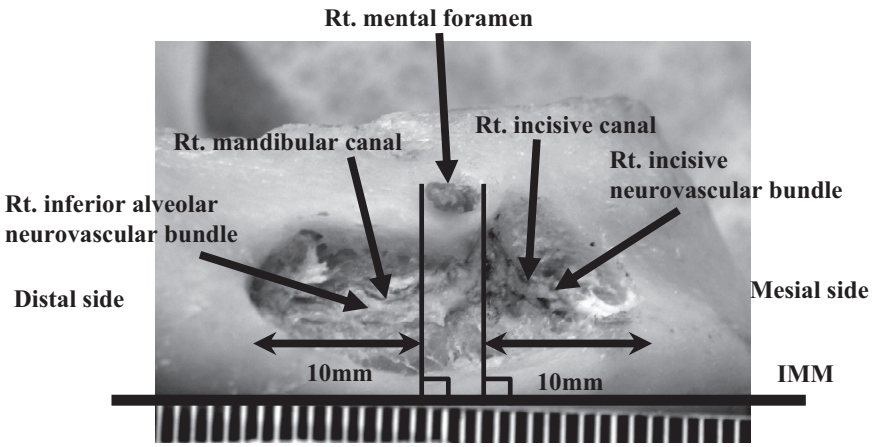

FIGURE 3. The range examined in the inferior alveolar and incisive neurovascular bundle. The examined range was between the inferior alveolar neurovascular bundle within the mandibular canal 10 mm posterior and parallel to the IMM from the point on the posterior-most margin of the mental foramen through which the perpendicular to the IMM passes, and the incisive neurovascular bundle within the incisive canal 10 mm anteriorly and parallel to the IMM from the point on the anterior-most margin of the mental foramen through which the perpendicular to the IMM passes.

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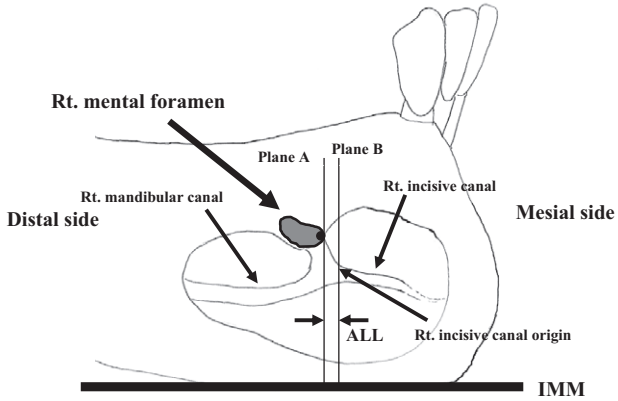

FIGURE 4. The 2 planes defined in this study and the anterior loop length (ALL) of the mandible (Rt). Planes A and B were defined when the mandible was placed on the flat experimental table. Plane A was the plane perpendicular to the IMM that passes through the anterior-most margin of the mental foramen. Plane B is the plane perpendicular to the IMM that passes through the anterior-most margin of the mandibular anterior loop (coincident with the origin of the incisive canal). Plane A and plane B were coincident in the absence of an anterior loop. The ALL is the shortest straight-line distance measured between plane A and plane B.

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MEASUREMENT ERRORS

The reproducibility of the measurements obtained was evaluated by randomly selecting a specimen used in the study, measuring the ALL and diameters using the methods previously described, and obtaining these measurements again 1 week later. The measurement errors obtained, which were calculated as the differences between corresponding measurements, were expressed in terms of s(i) values as follows:

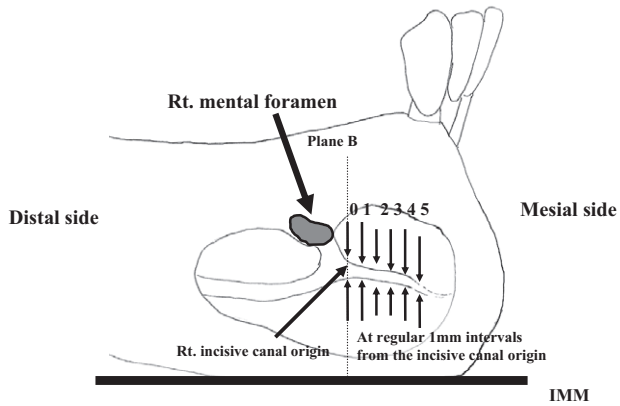

FIGURE 5. Diameter of the incisive canal (Rt). The diameter at the origin of the incisive canal (point 0) was defined as the internal diameter of the incisive canal formed by plane B. Each diameter of the incisive canal measured at 1-mm intervals toward the Md plane was parallel to the aforementioned plane B, and was defined as the internal diameter of the incisive canal at 1-mm intervals toward the Md plane up to 5 mm mesially.

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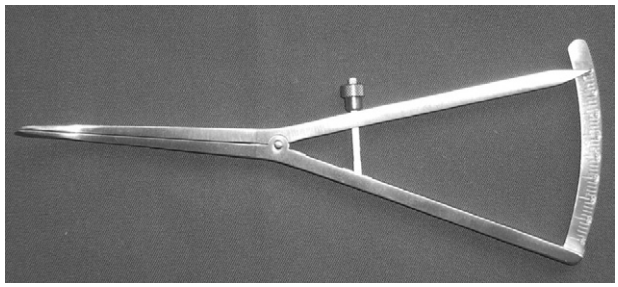

FIGURE 6. Calipers (Castroviejo 18-mm angled measuring calipers; Kohler). These stainless steel calipers are widely used in implant surgery and oral and maxillofacial surgery. These calipers were used for the measurement of the ALL and diameter. The calipers were placed across both ends of the distance of the ALL or diameter, the calipers were locked with the adjusting screw and marked, and the distance (of the ALL or diameter) measured using vernier calipers.

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$$s(i) = \sqrt{\frac{\sum (x_a - x_b)^2}{2N}}$$

STATISTICAL ANALYSIS

All calculations were processed using SPSS statistical software (Version 11.0J; SPSS Inc, Chicago, IL). Means and standard deviations were calculated for all measured values. To compare all measured values for right-left hemimandible, gender, age, and dental status, 2-group comparisons were performed using the unpaired *t* test and multiple-group comparisons using ANOVA. For the multiple comparison tests, ANOVA with post-hoc least significant difference test was used. *P* values less than .05 were considered statistically significant.

Results

RELIABILITY OF MEASUREMENTS

The measurement error was 0.05 mm or less for the ALL and diameters.

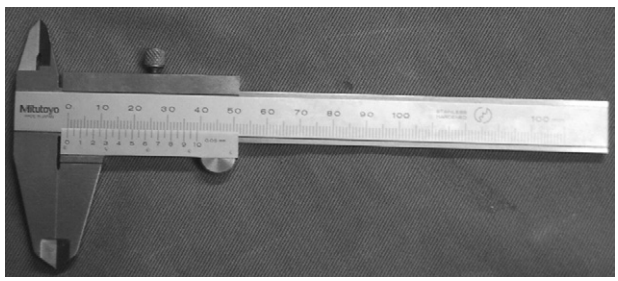

FIGURE 7. Vernier calipers (N10S; Mitutoyo Corporation). These stainless steel vernier calipers are widely used in implant surgery and oral and maxillofacial surgery for accurately measuring distances. These vernier calipers were used to accurately measure the distance marked by the calipers shown in Figure 6.

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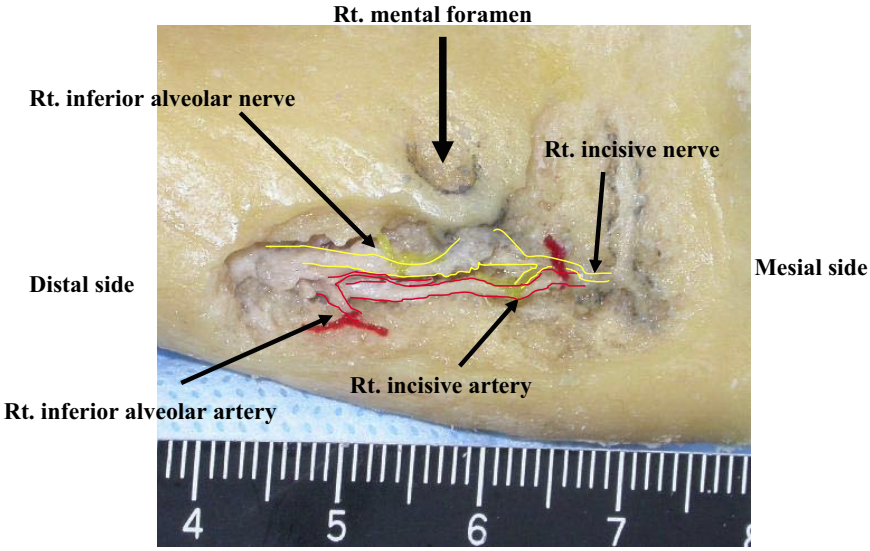

FIGURE 8. The identified inferior alveolar and incisive nerves. Using an illuminated magnifier (SKK-F-3; Otsuka Optics Corporation), the inferior alveolar and the incisive nerves were identified (magnification × 3). The nerves in the inferior alveolar neurovascular bundle within the mandibular canal that courses 10 mm posteriorly to the mental foramen, and the incisive neurovascular bundle within the incisive canal that courses 10 mm anteriorly to the mental foramen were identified under magnification. The inferior alveolar and the incisive nerves are indicated in yellow and the inferior alveolar and the incisive arteries in red.

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IDENTIFICATION OF NERVES IN THE INFERIOR ALVEOLAR AND INCISIVE NEUROVASCULAR BUNDLES

In the neurovascular bundles running from the mandibular canal 10 mm posterior to the mental foramen to the incisive canal 10 mm anterior to the mental foramen, nerves were present in all specimens (75 hemimandibles) (magnification × 3; Fig 8).

ALL AND DIAMETERS

An anterior loop was present in 47 of 75 hemimandibles from 38 cadavers (prevalence, 62.7%).

The mean values and standard deviations of the linear measurements for all specimens, right/left side, gender, age, and dental status are shown in Table 2. The specimens with the longest ALL and largest incisive canal diameter are shown in Figures 9 and 10, respectively.

Statistical comparison by the unpaired *t* test revealed no significant differences in ALL for right/left side or dental status ($P > .05$). However, ALL in males was significantly longer than that in females ($P = .02$). ANOVA performed for ALL in each age group showed a significant difference ($F = 2.99$; $P = .04$), and by the least significant difference test, only the 48 to 59 year group showed significantly larger values than the other age groups ($P < .05$) (48 to 59 vs 60 to 69, $P = .01$; 48 to 59 vs 70 to 79, $P = .007$; 48 to 59 vs 80 to 93, $P = .008$).

ANOVA performed for each incisive canal diameter at the origin (0 mm), and at 1, 2, 3, 4, and 5 mm mesially from the origin showed a significant difference ($F = 27.2$; $P < .0001$). The least significant difference test demonstrated significant differences for all groups (4 mm mesial group vs 5 mm mesial group only, $P = .011$; other intergroup comparisons, $P < .0001$), and as the measurements progressed from the origin to 5 mm mesially, the diameter of the incisive canal became statistically significantly narrower. The unpaired *t* test revealed no statistically significant differences in the diameter of the incisive canal because of right/left side, gender, or dental status ($P > .05$). The ANOVA comparison of incisive canal diameter by age group also disclosed no statistically significant differences ($P > .05$).

Discussion

In earlier measurements of the anterior loop and the incisive canal using cadavers, Bavitz et al,[5] Mardinger et al,[7,9] and Kuzmanovic et al[8] identified the inferior alveolar neurovascular bundle or the incisive neurovascular bundle. However, despite the fact that it is extremely important as to whether or not nerves are actually found in these neurovascular bundles, their presence was yet to be demonstrated. In the present research method, not only the inferior alveolar mandibular neurovascular bundle to the incisive neurovascular bundle in the region of the mental foramen, but also the nerves in the neurovascular bundles were identified under magnification, showing that nerves were indeed present in the range of measurement.

However, because the nerves are not suitable for landmarks, the mandibular canal and incisive canal were used in selecting the landmarks for the purpose of measurement. The reason for this is that cadavers are specimens fixed in formalin, and because the nerves are soft tissue, there is a high probability that they will be deformed, and will therefore be inexact as landmarks.

The Frankfort plane could not be used as a base plane because the mandible was detached from the

Table 2. ANTERIOR LOOP LENGTH AND DIAMETER OF THE INCISIVE CANAL

Group	Anterior Loop Length (ALL) (mm)			Diameter of the Incisive Canal (mm)																		
				Origin = 0 mm			1 mm Mesially			2 mm Mesially			3 mm Mesially			4 mm Mesially			5 mm Mesially			
	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
							**			**			**			**			*		
All (n = 75)	0.0-6.0	1.5	1.4	1.0-6.6	3.1	1.2	0.6-5.8	2.6	1.1	0.5-5.7	2.2	1.0	0.5-6.0	2.0	1.0	0.5-5.0	1.8	0.8	0.5-4.9	1.7	0.8
Side																					
Right (n = 37)	0.0-4.2	1.5	1.3	1.0-6.6	3.0	1.2	0.8-5.0	2.5	1.0	0.8-4.0	2.2	0.9	0.8-4.5	2.1	0.9	0.8-3.9	1.8	0.8	0.8-3.4	1.7	0.7
Left (n = 38)	0.0-6.0	1.5	1.6	1.0-6.2	3.2	1.2	0.6-5.8	2.6	1.2	0.5-5.7	2.3	1.1	0.5-6.0	2.0	1.1	0.5-5.0	1.8	0.9	0.5-4.9	1.7	0.8
Gender																					
Male (n = 43)	0.0-6.0	1.8 *	1.5	1.0-6.6	3.2	1.3	1.0-5.8	2.6	1.2	0.5-5.7	2.2	1.1	0.5-6.0	2.0	1.1	0.5-5.0	1.8	0.8	0.5-4.9	1.7	0.8
Female (n = 32)	0.0-4.0	1.1	1.2	1.0-5.3	2.9	0.9	0.6-4.7	2.6	0.9	0.8-4.1	2.3	0.9	0.8-4.1	2.0	0.9	0.8-4.0	1.9	0.8	0.8-3.0	1.7	0.6
Age																					
48-59 (n = 8)	1.4-4.2	2.9 * **	1.0	2.0-4.0	2.7	0.7	1.3-3.6	2.2	0.7	1.1-3.5	1.8	0.8	1.2-3.0	1.8	0.6	1.0-2.7	1.8	0.7	1.0-2.7	1.7	0.6
60-69 (n = 21)	0.0-6.0	1.4	1.6	1.0-6.6	3.4	1.5	1.0-5.0	2.7	1.3	0.5-4.1	2.3	1.1	0.5-4.1	2.1	0.9	0.5-4.0	1.9	0.8	0.5-3.4	1.7	0.5
70-79 (n = 20)	0.0-3.4	1.3	1.2	1.4-6.2	3.1	1.1	1.0-5.8	2.6	1.2	0.8-5.7	2.4	1.2	0.8-6.0	2.3	1.3	1.0-5.0	2.0	1.1	0.5-4.9	1.8	1.0
80-93 (n = 26)	0.0-4.2	1.4	1.4	1.0-4.8	2.9	1.0	0.6-3.8	2.5	0.9	0.8-3.8	2.2	0.8	0.8-3.3	1.9	0.8	0.8-3.0	1.6	0.7	0.8-3.1	1.6	0.6
Dental status																					
Dentate (n = 50)	0.0-6.0	1.7	1.5	1.0-6.6	3.2	1.3	0.6-5.8	2.5	1.2	0.5-5.7	2.1	1.1	0.5-6.0	2.0	1.1	0.5-5.0	1.8	0.9	0.5-4.9	1.7	0.8
Edentulous (n = 25)	0.0-4.0	1.1	1.1	1.1-4.4	2.9	0.8	1.1-4.2	2.7	0.8	1.1-3.8	2.5	0.8	1.0-3.7	2.2	0.8	0.8-3.9	1.9	0.8	0.8-3.1	1.7	0.6

*$P < .05$.

**$P < .01$.

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cadaver. Therefore, in this study the IMM and Md plane were selected as base planes to permit greater standardization and reproducibility.

Surgical measuring instruments were used in this study to obtain measurements in a more clinical setting. Because the measurement error was 10% or less of the standard deviation for linear measurements of the mental foramen region (Table 2), the present method of obtaining measurements was therefore considered to be reliable and accurate.

The length of the loop in cadavers or patients was reported to be 5 mm or less in previous studies conducted in the 10-year period from 1993 (Table 3).[5-8,12]

However, the maximum value of ALL measured in this study was greater than 5 mm, similar to the values reported by other researchers in the past 2 years.[10,11] Accordingly, before surgery to place an implant on the mesial side close to the mental foramen, it is necessary to hypothesize the case where the length of the loop from the mental foramen is 5 mm or longer. As well, because the standard deviations in this study and the reports from the last 2 years are larger (Table 3)[10,11] than the standard deviations published in the 10-year period since 1993,[5-8,12] one must consider preoperatively that the variation in the loop length may be large too.

The statistical comparison of the loop length in this study showed no significant differences in the comparison for side or dental status. However, because there were statistically significant gender and age differences, it may be that gender-related physique or aging plays a role. Further research into the comparison by height will therefore be required.

The Brånemark System manual[13] recommends that drilling commences from a location approximately 5 mm mesially from the mental foramen in the absence of an anterior loop, when installing endosseous implants in the most distal interforaminal area. It also recommends that drilling commences from a location approximately 5 mm from the loop when an anterior loop is present. However, Kohavi and Bar-Ziv[14] reported that even when endosseous implants were installed at a distance of 10 mm or more mesially from the mental foramen, sensory disturbance in the mental region occurred because of damage to a long incisive canal with a large diameter. The mechanism probably involves stretching of the inferior alveolar nerve main trunk accompanied by interference with the vascular supply and more or less serious dysfunction because a fixture placed anteriorly to the mental foramen can engage the incisive branch, as noted by Hirsch and Brånemark,[3] possibly injuring the inferior alveolar nerve. Accordingly, when placing implants mesially from the mental foramen, one must also consider not only the length of the anterior loop, but also the diameter of the incisive canal. From the

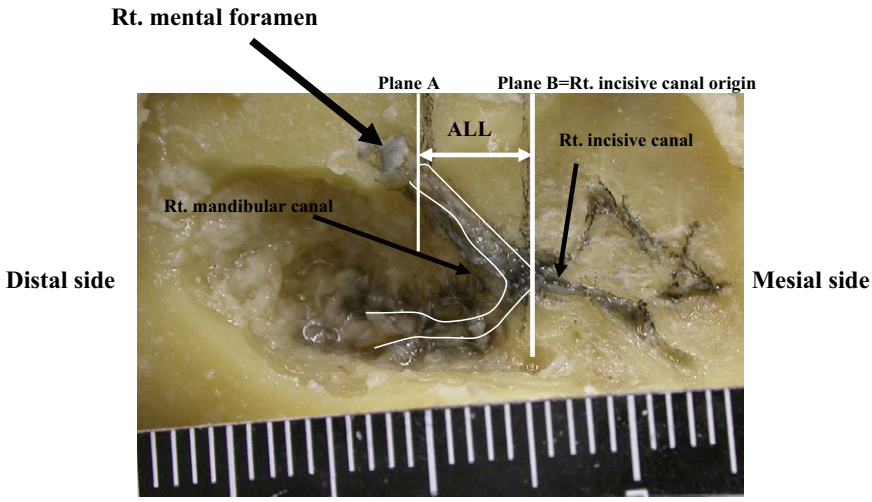

FIGURE 9. The specimen with the longest ALL, a length of 6 mm. It can be seen that the anterior loop of the mandibular canal was located a considerable distance mesially from the anterior margin of the mental foramen (plane A).

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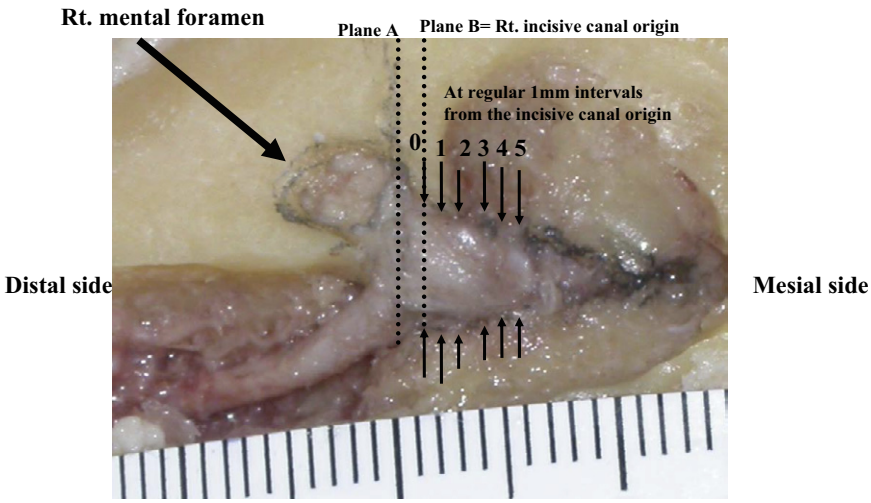

FIGURE 10. The specimen with the largest incisive canal diameter. The diameter of the incisive canal was 6.6 mm at its origin, then 4 mm, 5 mm, 5 mm, and 4.9 mm at 1-mm intervals mesially from the origin. It can be seen that the diameter of the incisive canal is considerably large, from its origin to as far as 5 mm in the mesial direction.

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Table 3. COMPARISON FOR DIRECTED MEASUREMENT OF THE ANTERIOR LOOP LENGTH

Authors	Materials	No. of Specimens	Incidence (%)	Length of Loop (mm) Mean ± SD (Range)
Bavitz et al[5] (1993)	Cadavers	24	11	
		Dentate group n = 24		0.2 ± 0.3 (0.0–1.0)
		Edentulous group n = 23		0.0 ± 0.0 (0.0–0.0)
Solar et al[6] (1994)	Cadavers	37	60	1.0 ± 1.2 (0.0–5.0)
Rosenquist[12] (1996)	Patients	58	26	0.15 (0.0–1.0)
Mardinger et al[7] (2000)	Cadavers	46 hemimandibles	28	1.05 ± 0.47 (0.4–2.19)
Kuzmmanovic et al[8] (2003)	Cadavers Caucasian descent	22 (44 hemimandibles)		1.2 ± 0.9 (0.11–3.31)
Neiva et al[10] (2004)	Caucasian skulls	22	88	4.13 ± 2.04 (1.0–11.0)
Hwang et al[11] (2005)	Cadavers Korean	30 fresh hemimandibles 50 dry hemimandibles		5.0 ± 1.9
Uchida et al	Cadavers Japanese	38 (75 hemimandibles)	62.7	1.5 ± 1.4 (0.0–6.0)

Uchida et al. Measurement of Anterior Loop Length. J Oral Maxillofac Surg 2007.

Table 4. DIAMETER OF THE INCISIVE CANAL IN THE MANDIBLE (ORIGIN AND 4 mm MESIALLY)

Authors	Hemimandibles	Origin Range Mean ± SD (mm)	4 mm Mesially Range Mean ± SD (mm)
Mardinger et al[9] (2000)	n = 46	1.00–2.90 2.09 ± 0.42	1.22–2.76 1.69 ± 0.38
Uchida et al	Japanese n = 75	1.0–6.6 3.1 ± 1.2	0.5–5.0 1.8 ± 0.8

Uchida et al. Measurement of Anterior Loop Length. J Oral Maxillofac Surg 2007.

statistical comparison, the diameter of the incisive canal measured in this research appears to become narrower from the origin to 5 mm mesially, in 1-mm increments. However, the mean diameters of the incisive canal at the origin and 4 mm mesially are larger than the figures presented in the previous report (Table 4),[9] and there were specimens with diameter of 6 mm or more at the origin, and 5 mm at 4 mm mesially. Moreover, in comparison with previous report,[9] the standard deviations of the present measurements were larger, and similar to the situation with the ALL. Therefore, when it is not considered preoperatively that the variation in diameter of the incisive canal is large and a fixture is placed anteriorly to the mental foramen, there is a possibility of sensory disturbance of the mental nerve region from injury to the incisive branch.

The present research showed that because there are large variations in the length of the anterior loop of the mandibular canal and the diameter of the incisive canal, it should not be assumed that there is a fixed distance mesially from the mental foramen at which it is safe to install endosseous implants in the most distal area of the interforaminal region.

When oral and maxillofacial surgeons install endosseous implants in the most distal portion of the interforaminal region, they must familiarize themselves with anatomic information obtained by measuring the length of the anterior loop of the mandibular canal and the diameter of the incisive canal on a case-by-case basis, via preoperative CT scans. If the preoperative CT scans show that the anterior loop is long or the incisive canal has a large diameter, the surgeon must inform the particular patient of the potential risk of postoperative injury to the mental nerve region. Moreover, as recommended by Adell et al,[15] during surgery, oral and maxillofacial surgeons should investigate the anterior loop or the incisive canal by inserting a dissector (Nobel Biocare, Goteborg, Sweden) from the mental foramen, to determine the location for installing the implant.

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