Clinical significance of the anterior loop of the mental nerve: anatomical dissection of a cadaver population

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Abstract

Purpose: The anterior loop (AL) of the mental nerve is an anatomical structure that should be considered when placing dental implants in the region of the mental foramen. This study aimed to evaluate the presence and dimensions of the AL using anatomical dissection of cadaver specimens.

Materials and methods: 20 cadaver specimens were dissected bilaterally yielding 40 sides. The mental foramen was probed before accessing the AL in order to determine the relationship between probing and actual AL length. The AL of the mental nerve was identified and measured through anatomical dissection.

Results: An AL was found in 22 sides (55%) with a range of 0,52mm to 4,29mm (Mean 1,18mm; SD 1,35mm). Probing versus actual AL length revealed a weak negative correlation between AL length and probe depth.

Conclusions: The study has shown that clinically significant AL lengths can be present and implant planning must therefore account for these AL.

Keywords: Anterior loop; Mental nerve; Dental Implant; Maxillofacial

List of Abbreviations

AL	Anterior Loop
CBCT	Cone Beam Computed Tomography
SCT	Spiral Computed Tomography

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Introduction

Dental implant placement in the region of the mental foramen has been known to cause neurosensory deficit due to nerve injury.[1-4] The identification and preservation of the anterior loop (AL) of the mental nerve is an important means of avoiding such neurosensory deficit.[5-7]

There is a general consensus that plain film radiographs are inadequate for the accurate identification of the AL. Bavitz et al[8] compared periapical radiographs to anatomical dissection on 24 cadaveric mandibles. They could not find a reliable relationship between the anatomical dissection and the periapical radiographs in determining the AL length. The radiographic examination revealed AL lengths of 0mm to 7mm while the anatomical dissection revealed AL lengths of 0mm to 1mm. A safety zone of 1mm was proposed to avoid injury to the mental nerve. Mardinger et al, in a similar study on 46 cadaveric hemi-mandibles showed that periapical radiography show false positive presence of an AL in 40% of the sample and failed to identify the AL in 70% of the sample.[9] AL length ranged from 0,5mm to 2,95mm on periapical films and 0,4mm to 2,19mm on anatomical dissection. They proposed a safety zone of 3mm anterior to the mental foramen.

Alternative imaging modalities such as Spiral Computed Tomography (SCT), as well as Cone Beam Computed Tomography (CBCT), have been used for the identification of the AL. The proposed advantage of these techniques is their ability to create an accurate three-dimensional representation of the structure under investigation, thus eliminating the error of image distortion inherent in plain film radiography.[10] Kaya et al[11] evaluated 73 preoperative patients using panoramic radiographs as well as SCT

Table 1. Proposed zone of safety

Reference	Year	Methodology	Proposed safety zone
Bavitz et al[8]	1993	Anatomical dissection Periapical radiography	1mm
Mardinger et al[9]	2000	Anatomical dissection Panoramic radiography	3mm
Kuzmanovic et al[1]	2003	Anatomical dissection Panoramic radiography	4mm
Li et al[14]	2013	SCT	5,5mm

for each patient. The radiographs and SCTs were evaluated for the presence and length of an AL bilaterally. Results showed that the SCT group identified a higher number of AL's and the mean length of the AL was 3mm versus a mean of 3.71mm for the panoramic radiograph group. Li et al[12] evaluated 68 SCTs of Chinese patients retrospectively and identified an AL in 83,1% of cases. The AL lengths ranged from 0mm to 5,31mm and the authors proposed a 5,5mm zone of safety to be maintained anterior to the mental foramen.

Uchida et al[13] compared CBCT measurements to anatomical dissection and concluded that CBCT confers a high degree of accuracy when assessing the presence of an AL.

Purely anatomical studies have been performed by a few workers. Rosenquist et al[14] evaluated the AL in 58 patients who received inferior alveolar nerve transposition prior to implant surgery. They showed an AL of 0mm to 1mm with a mean of 0.15mm. Benninger et al[15] in a study of 15 cadavers consisting of 30 sides showed the presence of an AL in only 4 sides, all of which did not exceed 1mm in length. They proposed that the large AL lengths previously described in the literature are anatomical aberrations, which are rarely encountered and thus the AL is of no clinical significance. Table 1 highlights the proposed safety zones postulated by various workers.[1,8,9,14]

The aim of our study was to evaluate whether a clinically significant AL does exist using anatomical dissection or whether the structure is of no clinical significance as has been recently asserted.

Materials and methods

Population

The study population consisted of cadaver specimens housed by the University of the Witwatersrand Department of Anatomical Sciences.

Dissection Procedure

The dissection was carried out by the same examiner for all specimens.

The dissection was performed on both sides of each mandible.

Soft tissues were reflected to expose the buccal surface of the mandible in the region of the mental foramen.

The mental foramen was probed using a Michigan probe, the depth of the infiltration of the probe was recorded. The buccal cortical plate was then removed to expose the inferior alveolar nerve and its branches.

The course of the inferior alveolar nerve was followed and if the nerve looped anterior to the foramen before exiting, this loop length was measured from the most anterior part of the loop to the anterior border of the mental foramen as shown in figure 1.

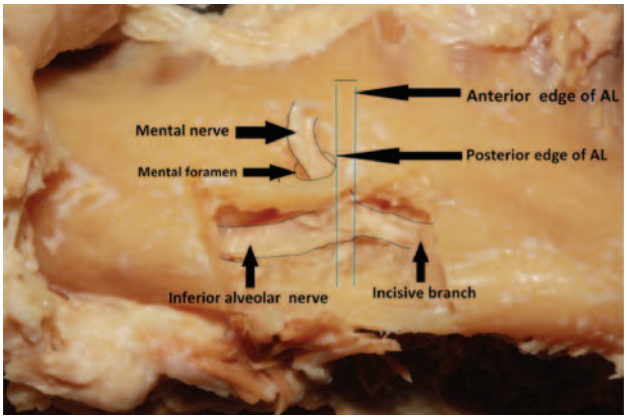

Figure 1: Determination of AL length.

Data Collection

Data was recorded on a standard data capture form. Data was recorded for the left and right side of each specimen.

Probing depths: the anterior depth of the mental foramen was probed and measurements were recorded

Anterior loop length: Any AL found was measured using a set of digital vernier calipers.

Data Analysis

The data was analysed using descriptive statistics and inferential statistics. The variables were grouped into Left and Right groups.

Study Reliability

All measurements were taken by the same examiner using the same set of instruments.

In order to test intraobserver reliability, repeat measurements were performed on 3 random specimens at the end of the data capture period.

The intraobserver error was noted at less than +/- 5% which was deemed acceptable.

Ethics

The study is covered by Waiver W-CJ-101109-1 issued by the University of the Witwatersrand school of Anatomical Sciences and as such does not require ethical clearance for health research performed on donated bodies.

Results

Demographics

The study population consisted of 20 specimens whose age ranged from 35 years to 94 years with a median age of 63 years.

Probing of mental foramen related to anterior loop length

Probing of the anterior part of the mental foramen yielded lengths ranging from 0mm to 8mm.

Table 2. Frequency of AL

	Right	Left
No AL	9	9
AL present	11	11

Table 3. Anterior loop length

	Right	Left
Minimum	1,01mm	0,52mm
Maximum	4,29mm	4,15mm
Mean	2,12mm	2,18mm
SD	1,00mm	1,26mm

A Spearman's rank correlation test was performed which revealed an R-value of -0,0015. This shows a weak negative correlation between probing the mental foramen and the actual AL length.

Anterior Loop Data

Anterior loop frequency

Table 2 shows the frequency of AL found in 40 sides of the dissected specimens. The AL was found in 55% of the sample and absent in the remaining 45%.

Anterior loop length

In those specimens where an AL was present, the length ranged from 1,01mm to 4,29mm (Mean 2,12mm; SD 1,00mm) on the right side and 0,52mm to 4,15mm (Mean 2,18mm; SD 1,26mm) on the left side. The combined mean value for all 40 sides was 1,18mm and the SD was 1,35mm.

The descriptive statistics for the AL are reported in Table 3.

A correlation test was performed which showed a 72,01% chance of the AL having a similar length as the contralateral side.

Discussion

Probing

In this study we found that probing the mental foramen does not allow for accurate identification of an AL. The lack of correlation between probing the mental foramen and the AL collaborates the findings of a previous study[16], therefore it is unreliable and not recommended that the presence of an AL be determined at the time of surgery using direct probing. Reasons for this might include perforation of the medullary bone with the instrument tip, or the instrument tip inadvertently entering the incisive canal when there is no AL present.

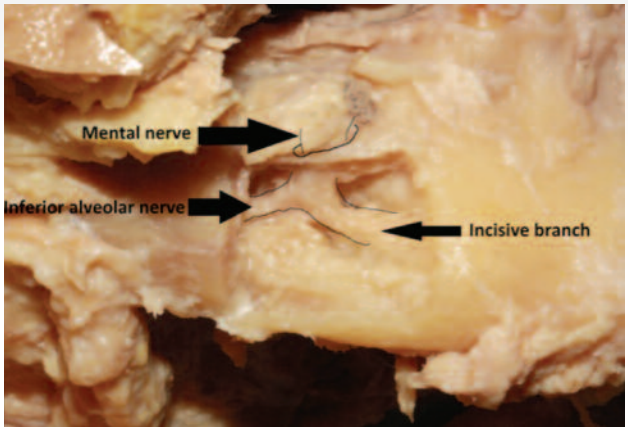

Figure 2a shows the morphology of the mental nerve where no AL is present.

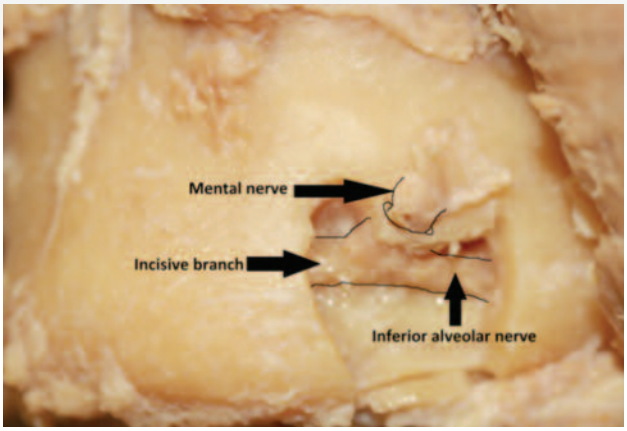

Figure 2b shows the morphology of the mental nerve where an AL is present – note the branching rather than looping pattern.

Anterior Loop

In this study, the AL was found in 55% of the sample and the length ranged from 0,52mm to 4,29mm (Mean 1,18mm; SD 1,35mm), however AL of 4mm or greater was found in 3 sides. There was a 72,01% chance that the AL on the contralateral side would be of equal length. An interesting observation was that the morphology of the AL was not a loop. The AL branched off the inferior alveolar nerve acutely and did not curve or loop as it passed toward the mental foramen. This is similar to the finding reported by Benninger et al[15] and perhaps indicates that the term 'anterior loop' is a misnomer since the actual morphology of this structure is a branch rather than a loop. Examples of this pattern are shown in Figure 2.

The AL range found in this study is contrary to those reported by Benninger et al[15] who found only 4 AL in 26 sides, all of which did not exceed 1mm in length. Even though there were no loops as large as those previously reported by Uchida et al[13] (9mm) the presence of loops greater than 4mm are significant and could have an impact on implant placement anterior to the mental foramen.

Conclusion

This study suggests that a weak negative correlation between probing the mental foramen and the actual AL length exist. Also, it appears that an observance of a 5mm safety zone (unless confirmed otherwise by 3D imaging such as CBCTs) or shorter implants are a safer option when it comes to implant placement anterior to the mental foramen. Further studies comparing anatomical dissection and CBCTs may give more clarity on the dimensions and clinical significance of the AL of the mental nerve.

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