

Prevalence and Measurement of Anterior Nerve Loop of the Inferior Alveolar Nerve Using CBCT

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ABSTRACT

Background: The present study was aimed to identify and measure variations in the presence and extent of the anterior loop of the inferior alveolar nerve using CBCT. 46 CBCT scan images of subjects aged between 21-56 years were randomly selected from the database of zonal dental hospital, and evaluated for the presence of anterior loop using imaging software. The prevalence of anterior loop was found to be 65.2% and the longest loop length recorded was 5.7 mm. anterior loop should be evaluated on case-by-case basis using CBCT during pre-surgical treatment planning involving anterior implant placement and no fixed distance mesial to the mental foramen should be considered safe.

Keywords: Anterior nerve loop; CBCT; prevalence; inferior alveolar nerve.

INTRODUCTION

Mental foramen is an important landmark when planning the placement of dental implants in the anterior mandible region.^{1,2} Placement of implants in this region may impinge on the inferior alveolar nerve or mental nerve, if it extends beyond the mental foramen due to the presence of anterior nerve loop (ANL). The ANL is defined as where the mental neurovascular bundle crosses anterior to the mental foramen then doubles back to exit the mental foramen.³

Whilst ANL is clinically not visible, it can be detected using a variety of diagnostic methods including conventional radiography, magnetic resonance imaging and computed tomography scans of patients and/or cadaver specimens. Data from the literature had reported higher prevalence of ANL in the mandible.⁴⁻⁶ However, most studies

had emphasized on determining the position of the mental foramen or visibility of the ANL, and only few studies have documented the actual length of ANL.⁷⁻⁹ Moreover, anterior loop length reported in the literature showed wide variations. The purpose of this study was to identify and measure variations in the presence and extent of the anterior loop of the inferior alveolar nerve using cone beam computed tomography scans (CBCT) and present a brief review of the literature on the anterior loop length.

MATERIALS AND METHOD

The study sample comprised 46 CBCT scan images of subjects aged between 21 to 56 years (mean age: 37.2 ± 1.36 years). The patient sample was collected randomly from the database of records at the zonal dental hospital. The patients had to have undergone CBCT within the previous

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Table 1: Distribution of anterior nerve loop (ANL) among the study sample.

Age group (in years)	No. of subjects	Presence of ANL (frequency)			Absence of ANL
		Both	Right	Left	
20-29	6	3	0	1	2
30-39	14	8	2	1	3
40-49	14	6	1	3	4
>50	12	5	0	0	7
Total	46	22	3	5	16

Table 2. Review of literature on the length of anterior nerve loop.

Authors	Year	Study sample	Range (mm)	Mean length (mm)
Bavitz et al	1993	Cadaveric Radiographs	0 -1 0 - 7.5	-
Solar et al	1994	Cadaveric	0.5 - 5	1
Rosenquist et al	1996		0 - 1	0.15
Mardinger et al	2000	Cadaveric	0.4 - 2.19	-
Kuzmanovic et al	2003	Cadaveric and panoramic	0.11 - 3.31	1.2
Neiva et al	2004	Cadaveric	1 - 11	4.13
Uchida et al	2007	Cadaveric	1 - 6.6	1.5
Apostolakis & Brown	2012	CBCT	0 -5.7	0.89
Rosa et al	2013	CBCT	0.15 - 6.6	2.4
Lu et al	2015	CBCT	-	1.46

six months. All the scans were taken with the same scanning equipment and by one radiographic technician over a period of time. In CBCT, hemi-mandibles were evaluated for the presence of ANL and measurement of anterior loop length was performed using imaging software. The loop length was obtained by the linear distance between the most anterior border of the mental foramen to the most anterior margin of the anterior loop. One oral and maxillofacial radiologist with experience in manipulation and interpretation of CBCT images performed the measurements. Descriptive statistics were applied where appropriate.

RESULTS

The anterior loop was detected in 65.2% of the samples using CBCT. Out of the 46 patients studied, 30 (65.2%) presented the ANL among which 22 (73.3%) presented bilaterally, three unilateral right sided and five were unilateral left (**Table I**). The length of the anterior loop showed variations between the right and left side ranging

from 0.16 mm to 5.7 mm in the evaluations. The longest length recorded was 5.7 mm and the mean anterior loop length in this study was 2.08 mm.

DISCUSSION

The mental nerve and its neurovascular bundle is an important surgical reference point during treatment planning involving placement of implants in the premolar/molar region.¹⁰ Inferior alveolar nerve injuries during dental implant surgery, either during preparation or placement of an implant remains a common and complex clinical problem. These injuries often result in post-operative neural disturbances.¹¹ Studies have documented varying lengths of anterior loop ranging from 0 - 11mm in the literature.^{2,3,7,8} [**Table 2**] Neiva et al⁴ had reported longest loop length of 11 mm. They detected the loop by probing the mesial wall of the mental canal. However, Misch (1999)¹² opined that it was not an accurate method to determine anterior loop length as it reflected penetration into the incisal canal. Wide variations in

the prevalence and length of anterior loop reported in the literature may be attributed to different criteria used to define the anterior loop, dissimilar diagnostic techniques, and diverse anatomic morphology of patients. The findings of anterior loop length in our cases ranged from 0.16 - 5.7 mm and the longest loop length was found to be 5.7 mm.

Most clinicians assess the position of inferior alveolar nerve canal using imaging techniques and aim to place the implants more than 2mm from the canal. Further, a 2mm zone of safety has been suggested to be left between an implant and the coronal aspect of the nerve on panoramic and periapical film prior to implant placement in the symphyseal region.¹³ In cases where the exact course and location of the mental canal and foramen are not identified, a minimum distance of 6 mm between the mental foramen and the most posterior implant has been recommended.² Varying safety-margin distances from mental foramen have been recommended as reference guides ranging from 1mm - 6 mm, to avoid injuries to the mental nerve while placing implants.^{1-3,7,14} Hence, authors corroborate the findings of others in that the assumption of a fixed distance anterior to mental foramen as safe position for the placement of an endosseous implant is not advised even with the current recommendation of a safety margin of 4-6 mm.^{7,15}

The use of conventional radiographs to determine the presence and extent of anterior loop length has been found to be unreliable,^{7,8} and has been attributed to poor radiographs or bone quality, and the inability to distinguish these structures from the trabecular pattern.⁷ Panoramic radiographs are not sufficient for pre-surgical implant planning in the mental region and may need to be supplemented with other modalities such as computed tomography scan for better visualization.^{16,17} CBCT has been found to be a more reliable imaging technique and provides accurate craniometrical and diagnostic information than conventional radiography.^{5,18,19} Chiu et al (2006)²⁰ had reported that it is the best method to obtain accurate pre-operative measurement of ANL in living patients. Use of CBCT scans and surgical corroboration of mental nerve position have been suggested when an anterior loop of the mental foramen is suspected of being present or if the zone

of safety (in mm) for implant placement is clear.¹³ Authors however, recommend either avoiding the surgical exposure of the mental foramen and/or use it as the last option, to locate the ANL owing to its limitations including nerve damage due to stretching or crushing of the mental nerve.¹³

Authors further opined that the use of a fixed distance anteriorly from the mental foramen as 'safe' distance should be avoided and anterior loop length should be analyzed on case-by-case basis using advanced imaging techniques like CBCT scans during pre-operative surgical planning involving dental implant placement in the interforaminal region of the mandible to avoid surgical complications.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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