REVIEW

Anterior Loop of the Mental Nerve and Its Radiologic Imaging: a Review

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Abstract

The mental foramen region is important for dental practise. When inferior alveolar nerve arises from the mandibular canal, it runs out ward, upward and backward to open at the mental foramen then it was called as "anterior loop of mental nerve". The correct visualization of anterior loop has an important role for planning of implant placement in preventing complications like paresthesia and bleeding. Reliability and precision of the images obtained with two-dimension conventional methods like periapical or panoramic radiography are limited when tracing the anterior loop. Cone beam computed tomography (CBCT) is a succesful method that provides three-dimensional imaging with low ionized radiation to image the anterior loop. In this article anterior loop of the mental nerve and its imaging will be discussed with literature information.

Keywords: Mental foramen, anterior loop, implant, paresthesia

Introduction

The mental nerve is a terminal branch of the inferior alveolar nerve (1). This nerve generally emerges from the mental foramen (MF) in three branches. The first branch gets the sensory impulses from the skin of the mental region, while the other branches get the sensory impulses from the lip skin, mucous membranes and gingival up to the second premolars (2,3). The inferior alveolar nerve can extend beyond MF like an intraosseous anterior loop (AL) (4). The intraosseous loop with a course of upwards, outwards and backwards of the inferior alveolar nerve originating from the mandibular canal to go out from the MF is called the "anterior loop of the mental nerve" (4,5,6) (Figures 1,2).

Figure 1: The left mental foramen (black arrow) on the panoramic radiograph; the anterior loop of the mental nerve within the intraosseous canal (thick white arrow) extending to the anterior of the mental foramen and the incisive canal (white arrow).

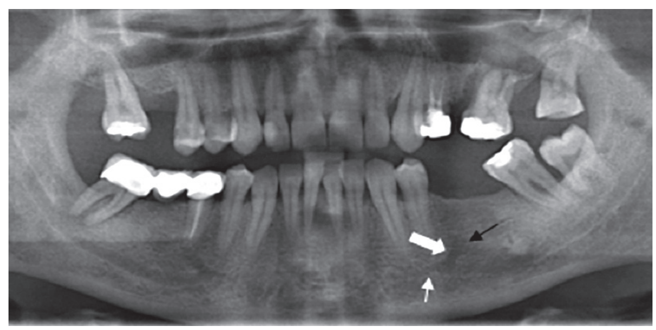
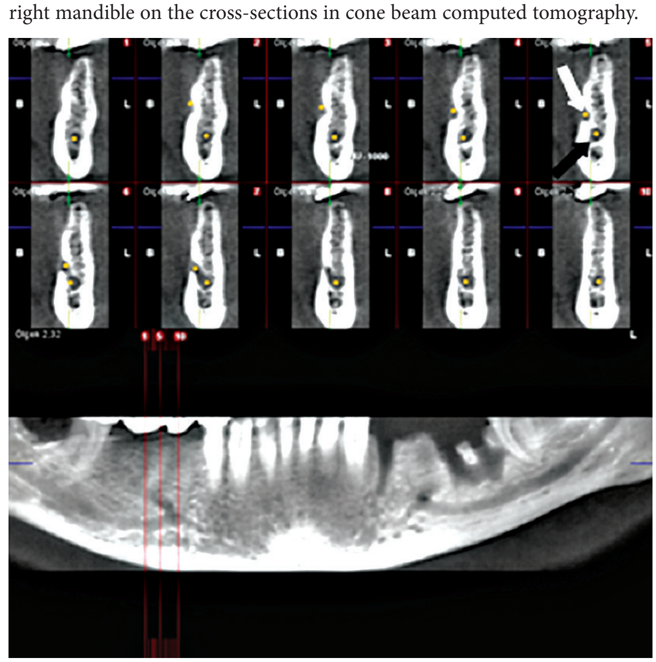


Figure 2: Observation of the mental canal (white arrow) and the mandibular canal (black arrow) as two separate canals along the anterior loop of the right mandible on the cross-sections in cone beam computed tomography.



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Importance of the Anterior Loop

Some neurosensory impairments including pain, paresthesia, and discomfort can develop related to the injury of the AL after implant application in the interforaminal area (7,8).

Taking the location of the MF and the AL of the mental nerve that can be at the mesial of the MF into consideration before the implant surgery is greatly important to prevent a potential mental nerve injury (9).

Presence of the Anterior Loop and Radiological Imaging

Presence of AL has been shown with anatomic on cadavers (10,11) and radiologic images (12,13,14) in several studies.

Solar et al. (10) reported that ALs with a mean length of 1 mm, ranging between 0.5 to 5 mm with a rate of 60% in their study on 37 cadaver mandibles. Neiva et al. (11) showed ALs with a mean length of 4.13 mm, ranging between 1 to 11 mm with a rate of 88% on 22 cadavers. Rosenquist found ALs with a mean length of 0.15 mm ranging between 0 and 1 mm with a rate of 26% (15 of 58) on mandible cadavers. AL was 0.5 mm long in 13 cadavers, and two cadavers had a 1 mm AL (15).

AL was detected by 7% in the study of Jacobs et al. carried out on 230 spiral computed tomography (CT) images taken before the implant planning (16). Li et al. found ALs with a rate of 83.1% and mean length of 2.09 mm (range: 0-5.31 mm) in their study of spiral CT sections of 68 Chinese patients (12). Apostolakis et al. found ALs with a rate of 48% and mean length of 0.89 mm (range: 0-5.7 mm) in their study on 93 patients with cone-beam computed tomography (CBCT) images (17). Luet al. the AL was identified in 85.2% of cases and the mean length of 1.46 mm on 732 hemimandibles with use CBCT scans (18). Ngeow et al. reported ALs on 66 sides (34.4%), their study performed on 97 panoramic radiographs. One or more ALs were visualized in 39 (40.2%) radiographs. ALs were most commonly seen bilaterally, followed by on the right side. They reported that visualization of AL decreased with age, and that there was no relation between gender and visualization (19).

False positive or false negative responses can be obtained for the ALs determined with periapical or panoramic radiographs as compared to the anatomic studies (4,5,20).

Arzouman et al. found significantly fewer loops as compared radiographs to anatomic evaulation (4) . Kuzmonavic et al. evaluated 22 mandibular cadaver specimen as radiological and anatomical. They identified AL on six panoramic radyography between 0.5 and 3 mm in length (27%) AL, while deduced AL between 0.11 and 3.31 mm lengths (average 1.20 ± 90 with the anatomical evaluation 35%) in eight dissected specimens (5). Mardinger et al. evaulated 46 hemimandibles with conventional radiography and dissections on cadavers. They found AL in only 13 hemimandibles (28%) as anatomically. Lenght of ALs ranged from 0.4 to 2.19 mm. There was found no correlation between the radiographic image and the anatomical shape of the loop. 40% were not found in anatomical examination, while ALs were seen as radiographically (20).

Uchida et al. measured AL lenght using CBCT in 4 cadavers, and using anatomy in 71 cadavers. In the anatomic measurements, they measured loops with a mean diameter of 1.9±1.7 mm, and lengths ranging between 0 and 9 mm. They reported that the average inconsistencies between CBCT and anatomic measurements were 0.06 mm or less for AL lenght (21). Naitoh et al. reported in their study on 28 CBCT and 28 multislice CT images that both methods were consistent with each other when tracing the neurovascular structures of the mandible (22). In their study on the anatomic structures in the interforaminal area with CBCT images, Parnia et al. concluded that traceability of the AL was very successful (9).

Reliability and precision of the images obtained with two-dimension conventional methods like periapical or panoramic radiography are limited when tracing the AL (2,19,23). Today, CBCTsystems have been designed for the imaging of the hard tissues in the maxillofacial area (24). While CBCT allows imaging of the anatomic structures in all the three orthogonal planes (axial, coronal and sagittal), it also allows imaging without magnification or distortion in oblique and inclined surfaces thanks to its multiplaner reformation feature (25). The greatest advantages against the conventional CT include images with high diagnostic quality with sub-millimeter resolution with much less radiation dosage (24).

Conclusion

Panoramic radiographs must not be relied on when determining the AL with conventional radiographs because of high rates of false positive or false negative interpretations. CT systems must be preferred before the implant planning in the interforaminal region. The high-quality diagnostic images provided by CBCT as compared to the medical CT with lower radiation doses must be kept in mind under the light of ALARA (As Low As Reasonably Achievable) principle. In case the AL of the mental nerve cannot be determined definitely, placement of the implant at a distance of about 6 mm to the most anterior point of the MF to avoid any neurological complication.

References

1. Rodella LF, Buffoli B, Labanca M, Rezzani R. A review of the mandibular and maxillary nevre supplies and their clinical relevance. Arch Oral Biol. 2012;57(4):323-34.
2. Mraiwa N, Jacobs R, Moerman P, Lambrichts I, vanSteenberghe D, Quirynen M. Presence andcourse of theincisivecanal in the human mandibular interforaminal region: two-dimensional imaging versus anatomical observations. SRA 2003;25:416-23.
3. Snell R. Clinical Anatomy for Medical Students. 7th ed. Maryland: Lippincott Williams &Wilkins; 2004. p.768- 85.
4. Arzouman MJ, Otis L, Kipnis V, Levine D. Observations of the anterior loop of the inferior alveolar canal. Int J Oral Maxillofac Implants. 1993;8(3):295-300.
5. Kuzmanovic DV, Payne AG, Kieser JA, Dias GJ. Anterior loop of the mental nerve: a morphological and radiographic study. Clin Oral Implants Res. 2003;14(4):464-71.

6. Bavitz JB, Harn SD, Hansen CA, Lang M. An anatomical study of mental neurovascular bundle-implant relationships. Int J Oral Maxillofac Implants. 1993;8(5):563-7.

7. Wismeijer D, vanWaas MA, Vermeeren JI, Kalk W. Patients' perception of sensory disturbances of the mental nevre before and after implant surgery: a prospective study of 110 patients. BrJ Oral MaxillofacSurg. 1997;35(4):254-9.

8. Abarca M, vanSteenberghe D, Malevez C, De Ridder J, Jacobs R. Neurosensory disturbance safterimmediate loading of implants in the anterior mandible: an initial questionnaire approach followed by a psychophysical assessment. Clin Oral Investig. 2006;10:269-77.

9. Parnia F, Moslehifard E, Hafezeqoran A, Mahboub F, Mojaver-Kahnamoui H. Observation of buccal foramen in mandibular body using cone-beam computed tomography. Med Oral Patol Oral CirBucal. 2012; 1;17 (3):e420-5.

10. Solar P, Frey G, Ulm C, Gruber H, Matejka M. A Classification of the intra osseous paths of the mental nerve. Int. J. oral max. Fac. Implant. 1994;9(3): 339-44.

11. Neiva RF, Gapski R, Wang HL. Morphometric analysis of implant-related anatomy in Caucasian skulls. J Periodontol. 2004;75(8):1061-7.

12. Li X, Jin ZK, Zhao H, Yang K, Duan JM, Wang WJ. The prevalence, length and position of the anterior loop of the inferior alveolar nerve in Chinese, assessed by spiral computed tomography. SurgRadiol Anat. 2013;35(9):823-30.

13. Jalili MR, Esmaeelinejad M, Bayat M, Aghdasi MM. Appearance of anatomical structures of mandible on panoramic radiographs in Iranian population. ActaOdontol Scand. 2012;70(5):384-9.

14. Rosa MB, Sotto-Maior BS, MachadoVde C, Francischone CE. Retrospectivestudy of the anterior loop of the inferior alveolar nevre and the incisive canal using cone beam computed tomography. Int J Oral MaxillofacImplants. 2013;28(2):388-92.

15. Rosenquist B. Is there an anterior loop of the inferior alveolar nerve? Int J Periodontics RestorativeDent. 1996;16(1):40-5

16. Jacobs R, Mraiwa N, vanSteenberghe D, Gijbels F, Quirynen M. Appearance, location, course, and morphology of the mandibular incisive canal: an assessment on spiral CT scan. Dentomaxillofac Radiol. 2002;31(5):322-7.

17 Apostolakis D, BrownJE. The anterior loop of the inferior alveolar nerve: prevalence, measurement of its length an recommendation for interforaminal implantin stallation based on cone beam CT imaging. Int J Oral Maxillofacial Implants. 2013;28(1):117-24.

18. Lu CI, Won J, Al-Ardah A, Santana R, Rice D, Lozada J. Assessment of the Anterior Loop of theMental Nerve Using Cone Beam CT-Scan. J Oral Implantol. 2014 Feb 19. [Epubahead of print]

19. Ngeow WC, Dionysius DD, Ishak H, Nambiar P. A radiographicstudy on the visualization of the anterior loop in dentate subjects of different age groups. Oral Sci. 2009;51(2):231

20. Mardinger O, Chaushu G, Arensburg B, Taicher S, Kaffe I. Anterior loop of the mental canal: an anatomical-radiologic study. Implant Dent. 2000;9(2):120-5.

21. Uchida Y, Noguchi N, Goto M, Yamashita Y, Hanihara T, Takamori H, Sato I, Kawai T, Yosue T. Measurement of anterior loop length for the mandibular canal and diameter of the mandibular incisive canal to avoid nevre damage when installing endosseous implants in the interforaminal region: a second attempt introducing cone beam computed tomography. J Oral Maxillofac Surg. 2009;67(4):744-50

22. Naitoh M, Nakahara K, Suenaga Y, Gotoh K, Kondo S, Ariji E. Comparison between cone beam and multislice computed tomography depicting mandibular neurovascular canal structures. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010;109(1):e25-31.

23. Jacobs R, Mraiwa N, Van Steenberghe D, Sanderink G, Quirynen M. Appearance of the mandibular incisive canal on panoramic radiographs. Surg Radiol Anat. 2004;26(4):329-33.

24. Scarfe WC, Farman AG, Sukovic P.Clinical Applications of Cone-Beam Computed Tomography in Dental Practice. J Can Dent Assoc. 2006; 72(1):75–80

25. Scarfe WC, Farman AG. What is Cone-Beam CT and How Does it Work? DentClin North Am. 2008;52(4):707-30