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A Retrospective Cone Beam Computed Tomography (CBCT) Study of the Assessment of the Length of the Anterior Loop of the Inferior Alveolar Nerve

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ABSTRACT

Objectives: Interforaminal implant surgery requires anatomical knowledge of the area and adequate information on the location of the various landmarks of significance such as the mental foramen, the anterior loop of the inferior orbital nerve and the mandibular incisive canal using Cone beam computed tomography (CBCT). This information may be used to provide recommendations to the surgeon without access to a 3D scan of the dento-alveolar region.

Materials and methods: 65 patients scanned with 'i-CAT" device for a variety of clinical indications were included. Using the device's software the gender prevalence and length of the anterior loop was assessed.

Results: The results show that an anterior loop was present with a mean of 3.40 mm in males and 2.85 mm in females as identified in an Indian sub-population. There was no significant difference in the loop length between the right and left side of the mandible.

Conclusion: As the anterior loop length shows a high degree of variability, these findings suggest that a CBCT for each patient is recommended in order to visualise a safety zone before placing implants close to the mental foramen.

Key words: CBCT, Anterior loop, Mandibular nerve

I. INTRODUCTION

The fifth cranial nerve i.e. trigeminal nerve which is also known as the dentist's nerve branches out to form the inferior alveolar nerve which is contained in the neurovascular bundle and located in the mandibular canal[1]. It leaves the canal from the mental foramen which is anatomically in the anterior wall of the premolar region of the alveolar bone and the final portion sometimes passes below the inferior border and the anterior wall of the mental foramen thus giving off a small incisive branch, that ultimately curves back to enter the foramen and emerge into the soft tissues, thus becoming the mental nerve [1-3]. This anatomical significance is that of the 'anterior loop' of the inferior alveolar nerve [4]. Selective surgery in this area such as implant placement in the interforaminal region may interfere with presence of the anterior loop especially in cases of limited bone availability or the need for longer implants and may result in neurosensory disturbances in the lower lip and chin. In order to prevent the violation under such conditions, a 5mm safe distance from the most distal fixture from the anterior loop has been proposed. In order to ensure the success of the surgery and to prevent iatrogenic complications, the accurate identification of this benign anatomic variation is essential for surgical planning [5]. Strikingly variable results regarding the prevalence of anterior loops of

the inferior alveolar canal have been reported in the literature, with a maximum length of 11mm [6, 7].

Various evaluation techniques for the anterior loop study, like clinical identification with the use of a probe, panoramic radiography, intraoral periapical radiographs, computed tomography CT scans have been traditionally used but they have limited reliability and accuracy[5]. An advanced digital imaging technique Cone beam computed tomography (CBCT) has been considered the standard method for assessing bone tissue based on the good relation cost effectiveness, shorter time of acquisition, high power resolution and 1/15 less radiation exposure compared to CT and is able to determine the presence and length of the anterior loop with better precision and reliability [7].

It should be highlighted that significant individual anatomical variations are present to various extents among different populations and ethnic groups. It is the aim of my current observational study –

- ✓ To assess the presence of anterior loop
- ✓ To assess the length of anterior loop
- ✓ To compare the length of anterior loop in males and females
- ✓ To compare the length of anterior loop in right and left side of mandible

II. MATERIALS AND METHODS

The study cohort comprised of 65 random volunteers whose CBCT scans were included considering 1) they were of adequate diagnostic quality 2) the front part of body of mandible bilaterally included in volume 3) no fractures or bone pathologies that compromised the region of the mental foramen. The exclusion criteria was the presence of implants or metal artefacts located in the foramen region.

All CBCT scans were acquired using an i-CAT Next Generation unit (Imaging Sciences International, Hatfield, PA, USA). The images were reconstructed using XORAN CAT version 2.0.21 (Xoran Technologies, Ann Arbor, MI, USA). Multiplanar reconstructions included axial, coronal, and sagittal images were obtained and evaluated by two radiologists. The cases were categorized by side (left and right), gender (male and female). The presence of the anterior looping and its length were measured.

We measured the anterior loop according to the study from Apostolakis and Brown[7], whereby, if a single round hypodense image with a diameter larger than 3 mm was visualized, it was interpreted as the anterior extension of the mandibular canal and was considered as the anterior loop in our study. Furthermore, it was also considered to be present when 2 round hypodense areas were observed, alongwith one corresponding to the lumen of the mandibular canal that traverses the mental foramen anteriorly and inferiorly, and the other reflecting the doubling back (loop) of the mandibular canal, leading to the externalization of the inferior alveolar nerve, as previously described[8]. The length of the anterior loop was determined using the amount of consecutive coronal reconstructions situated between the anterior border of the mental foramen and the anterior border of the loop multiplied by the thickness of the slices (0.25 mm).

III. RESULTS

The ALL was evaluated among 65 patients (130 sides). The ages of these patients range from 23 years to 81 years, mean age being 55.72 years. The findings were analysed according to absence or presence of the ALL (Anterior loop length), size or length of ALL and gender of the patient. An anterior loop was identified in 104 sides (80%) and was absent on 26 sides (20%) out of the total sample size (See figure 2). The absence was bilateral in 8 patients i.e. 16 sides.

There were 20 males (30.76%) and 45 females (69.23%) in the study (See figure 1). The mean length in males

was 3.4 mm and in females was 2.85 mm, thus the total mean length being 3.12 mm (See figure 3) . Thus the mean ALL was found to be greater in males than females.

The mean length of the anterior loop was almost similar on the right and left sides. The mean ALL on right side was 2.995 mm and that on the left side was 2.953 mm(See figure 4).

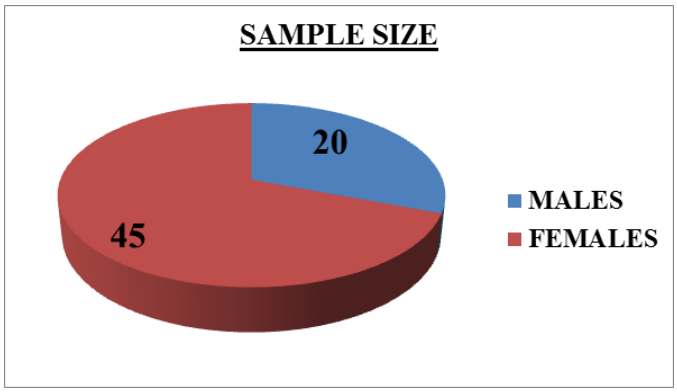

Figure 1. Distribution of the gender in the sample

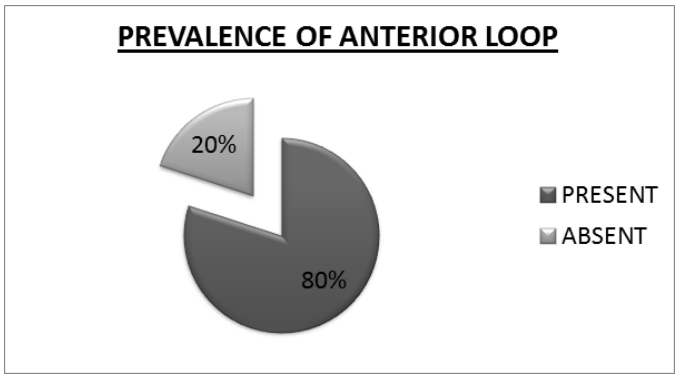

Figure 2. Prevalence of the anterior loop in the sample.

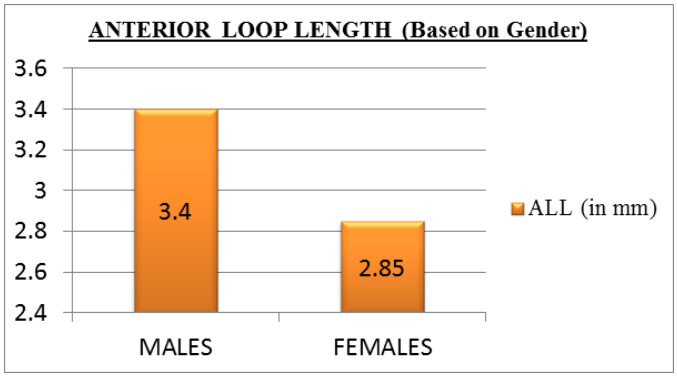

Figure 3. Length of the anterior loop among the genders.

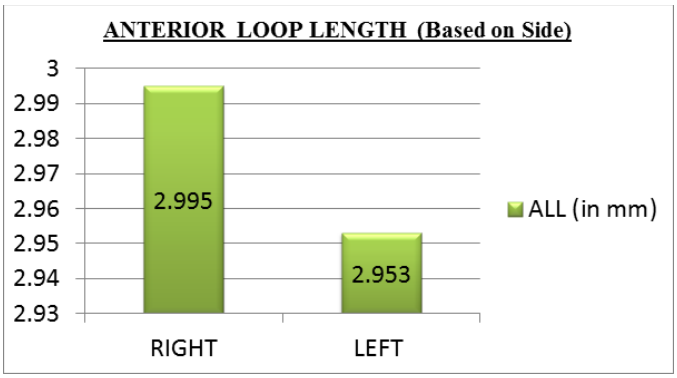

Figure 4. Distribution of the length of the anterior loop on the left and right side of the mandible

IV. DISCUSSION

The evaluation of details regarding the anterior loop are a relatively new area of research and most studies have been conducted in the recent years. The increased interest is directly related to the upcoming awareness and demand for operations to place dental implants.

Several methods have been used to assess the variable anatomy of the anterior loop including panoramic radiography, CT, CBCT and other radiographic methods[5-7, 9]. The anterior loop was present in 80% cases according to our study, and the relatively lower prevalence reported in earlier studies[5, 10] may be attributed to the failure of two-dimensional panoramic radiography to detect its presence also due to distortion or overlapping structures[11, 12]. Whereas CBCT resembles medical computerized tomography on the bone and the three-dimensional view makes it reliable and accurate.

The mean length in our study was reported to be 3.12 mm. The longest loop in the literature is reported by Neiva et al.[13] being 11mm, followed by Uchida et al.[4, 14] with a length of 9mm. The 100% safe distance without the use of CBCT would be 6mm but this would highly limit the available space for placing implants and even the size of the implants that could be used. Hence, placing the implants 3 mm away from the mental foramen is considered safe, but because

there are many cases even more than 3 mm it is mandatory to get a CBCT for pre-surgical planning of implant placement. It should also be remembered that the most distal interforminal fixture must be observed. Other studies have shown the length of the anterior loop to be significantly related to male gender and the right side[4, 7, 10, 14]. According to this study, the mean length in males (3.40 mm) was greater than the mean length in females (3.12mm). But the mean value of the right side (2.995mm) was not majorly larger than the left side (0.2953mm). The mean age of these 65 patients was 55.72 years.

Sources of errors in these measurements may be due to the partial inclusion of the end-points within the first and last cross-sectional slices, the partial volume averaging effect, small movement artefacts, artefacts included by dental materials, limited contrast resolution, and human dexterity. These errors, however, are random in nature and no systemic errors have been introduced in our study.

V. CONCLUSION

The higher prevalence and wide variability of the anterior loop in this study strongly highlights the importance of knowledge regarding this anatomical variation and the need for its evaluation prior to surgical implant placement. It is important that professionals identify and measure the ALL when planning procedures involving the interforaminal region to avoid the possible complications. It is suitable to use CBCT for implant planning to correctly identify the course of the mandibular nerve and accurately view the anatomical landmarks.

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VI. REFERENCES

[1]. Walker HK. Cranial Nerve V: The Trigeminal Nerve. In: rd, Walker HK, Hall WD, Hurst JW, eds. Clinical Methods: The History, Physical, and Laboratory Examinations. Boston, 1990.

[2]. David OJ. [Anatomy of the trigeminal nerve]. Revista de la Facultad de Odontologia 1977;9:95-121.

[3]. Yang HJ, Gil YC, Lee HY. Anatomy of facial and trigeminal nerve branches associated with the corrugator supercilii muscle: microdissection and modified Sihler staining. Dermatologic surgery : official publication for American Society for Dermatologic Surgery [et al] 2015;41:87-93.

[4]. Uchida Y, Yamashita Y, Goto M, Hanihara T. 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. Journal of oral and maxillofacial surgery : official journal of the American Association of Oral and Maxillofacial Surgeons 2007;65:1772-1779.

[5]. Juan del VL, Grageda E, Gomez Crespo S. Anterior loop of the inferior alveolar nerve: Averages and prevalence based on CT scans. The Journal of prosthetic dentistry 2016;115:156-160.

[6]. Rosenquist B. Is there an anterior loop of the inferior alveolar nerve? The International journal of periodontics & restorative dentistry 1996;16:40-45.

[7]. Apostolakis D, Brown JE. The anterior loop of the inferior alveolar nerve: prevalence, measurement of its length and a recommendation for interforaminal implant installation based on cone beam CT imaging. Clinical oral implants research 2012;23:1022-1030.

[8]. do Nascimento EH, Dos Anjos Pontual ML, Dos Anjos Pontual A, et al. Assessment of the anterior loop of the mandibular canal: A study using cone-beam computed tomography. Imaging science in dentistry 2016;46:69-75.

[9]. Rosa MB, Sotto-Maior BS, Machado Vde C, Francischone CE. Retrospective study of the anterior loop of the inferior alveolar nerve and the incisive canal using cone beam computed tomography. The International journal of oral & maxillofacial implants 2013;28:388-392.

[10]. 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. Surgical and radiologic anatomy : SRA 2013;35:823-830.

[11]. Kaya Y, Sencimen M, Sahin S, Okcu KM, Dogan N, Bahcecitapar M. Retrospective radiographic evaluation of the anterior loop of the mental nerve: comparison between panoramic radiography and spiral computerized tomography. The International journal of oral & maxillofacial implants 2008;23:919-925.

[12]. Kuzmanovic DV, Payne AG, Kieser JA, Dias GJ. Anterior loop of the mental nerve: a morphological and radiographic study. Clinical oral implants research 2003;14:464-471.

[13]. Neiva RF, Gapski R, Wang HL. Morphometric analysis of implant-related anatomy in Caucasian skulls. Journal of periodontology 2004;75:1061-1067.

[14]. Uchida Y, Noguchi N, Goto M, et al. 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: a second attempt introducing cone beam computed tomography. Journal of oral and maxillofacial surgery : official journal of the American Association of Oral and Maxillofacial Surgeons 2009;67:744-750.