Anterior Loop Length of the Inferior Alveolar Nerve to Estimate Safe-Zone for Implant-planning in Malaysian-Chinese Population

SHAMENI VELLAPPAN KONASILAN, TOH KAI YING, PRAVINKUMAR G. PATIL

School of Dentistry, International Medical University, Malaysia

Introduction

The anterior loop (AnL) of the inferior alveolar nerve (IAN) is an important clinical landmark in implant dentistry as it may be injured during implant placement.

In full-arch implant-supported fixed prosthesis, the AnL of the IAN limits the placement of implants in the mental foramen area by being a determining factor in minimising the distal cantilever length.[1,2]

Chen et al. found that the Taiwanese had a longer anterior loop length (AnLL) than the Americans. The differences in AnLL between the Taiwanese and Americans may be partially due to the racial influence.[3]

The purpose of this retrospective study was to measure the prevalence of the AnL of the IAN and estimate side-, gender-, and age-related variations in AnLL in the Malaysian-Chinese population.

Methodology

A total of 244 cone-beam computed tomography (CBCT)-Digital Imaging and Communications in Medicine (DICOM) files were chosen through simple random sampling from the pool of ongoing or completed cases in the Oral Health Centre at the International Medical University in Malaysia.

Inclusion criteria (Fig. 1):

- ✓ Dentulous, partially or fully edentulous Malaysian-Chinese patients between the ages 18 and 80.
- ✓ Medically fit, medically compromised, and previously irradiated patients but not involving the interforaminal region.

Exclusion criteria (Fig. 1):

- × Patients with congenital or developmental anomalies, any syndrome affecting the mandible, history of trauma, or pathology in the mandible such as cysts and tumours.
- × Patients with a history of surgical intervention to the interforaminal region such as orthognathic surgery or chin graft harvesting procedures.
- × Distorted or blurred CBCT images.

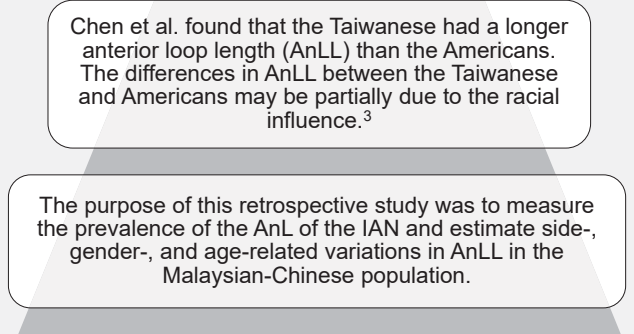

Fig. 1. A. Fully dentulous B. Pathology in the mandible C. Implants in the interforaminal region D. Distorted CBCT image

The CBCT-DICOM files were imported into the i-CAT software. The implant screen allowed multi-dimensional viewing of the jaw on the same screen (Fig. 2).

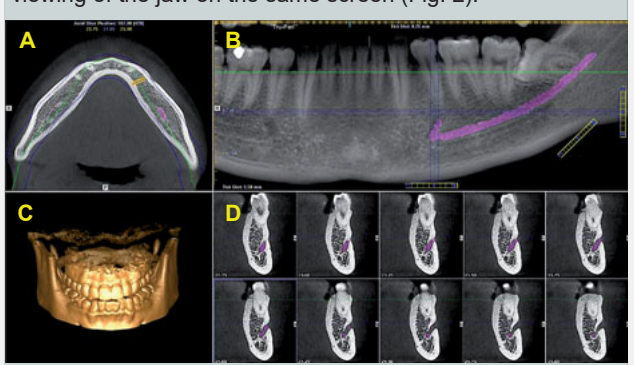

Fig. 2. Multidimensional evaluation of AnL of the IAN. A. Axial view B. Panoramic view C. 3-dimensional (3-D) view D. Sagittal view

All images were interpreted by the same observer, and 12 images were randomly selected to be reviewed again 2 weeks later to ensure intra- and inter-examiner reliability with a minimum Cronbach's alpha value of 0.8 achieved (Fig. 3).

Fig. 3. Intra- and inter-examiner reliability testing were performed.

The IAN was traced and highlighted to identify its route throughout the mandible until it exited the mental foramen in the i-CAT software (Fig(s). 4, 5 and 6).
Data collected were:
A) Existence of the AnL of the IAN.
B) Average AnLL on the left and right side of the mandible.

Fig. 4. Panoramic view of the mandible. Trajectory of the IAN until it exited the mental foramen was highlighted in pink.

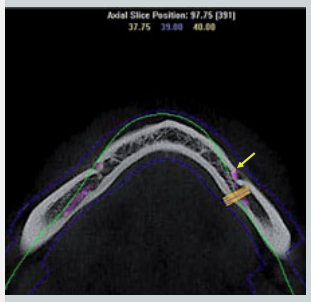

Fig. 5. Axial view of the mandible. Anterior border of the mental foramen was indicated by the arrow. The course of the IAN was highlighted in pink.

Fig. 6. Sagittal view of the mandible. Point 1 was the exit of the IAN from the mental foramen. Point 2 was the anterior-most margin of the AnL of the IAN. The IAN was highlighted in pink.

The exit of the IAN from the mental foramen and the anterior-most margin of the AnL of the IAN was located on the sagittal view (Fig. 6) and translated as points 1 and 2 respectively on the panoramic view (Fig. 7). A line connecting points 1 and 2 was made and the measurement was recorded as the actual AnLL of the IAN (Fig. 7). Another measurement was done on the opposite side of the mandible.

Fig. 7. Oblique line drawn connecting points 1 and 2 was recorded as the actual AnLL. The course of the IAN was highlighted in pink.

Statistical data analysis was performed using the software (SPSS statistics version 24.0; IBM Corp) with the level of significance set at $P < 0.05$. Data were analysed using:

- Paired samples T-test
- Independent T-test
- One-way analysis of variance

Results

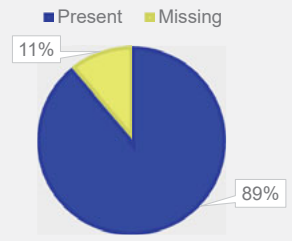

Fig. 8. Prevalence of AnL of the IAN

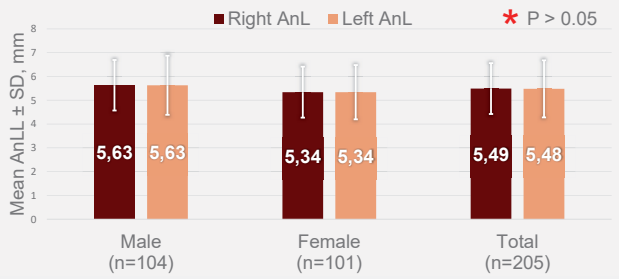

Fig. 9. Comparing mean AnLL of the IAN between the left and right sides

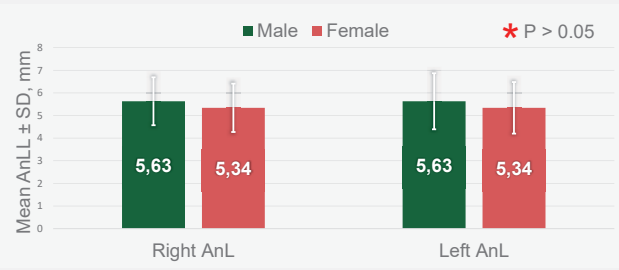

Fig. 10. Comparing mean AnLL of the IAN between male and female

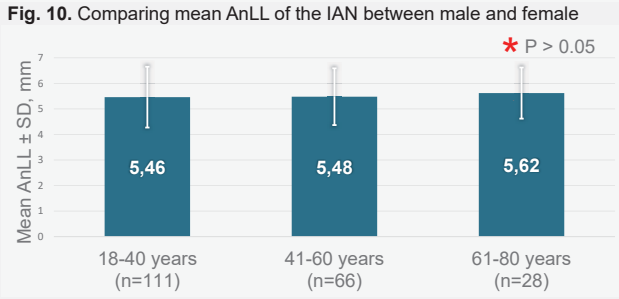

Fig. 11. Comparing mean AnLL of the IAN between different age groups

Discussion

This study measured the actual AnLL along its long axis which was oriented diagonally in the mandible as shown in Fig. 7.[1]

The mean AnLL was found to be greater in this present study when compared to the study done by Wong and Patil[4], which had a smaller sample size (n=34) of Malaysian-Chinese.

Both the AnLL and mesiodistal spread of AnL of the IAN can directly suggest the safety limit near the mental foramen in the horizontal and vertical direction by using the mental foramen as a reference point.
This could be an appropriate clinical recommendation in radiographic evaluation, especially when surgeons do not have access to CBCT.

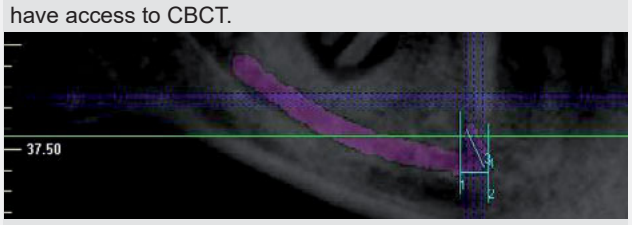

Fig. 12. Panoramic view of the mandible. Horizontal line connecting points 1 and 2 represented the mesiodistal spread of the AnL of the IAN. Point 1 was the posterior-most confine of the mental foramen where the nerve exited and point 2 was the anterior-most confine of the AnL of the IAN. Oblique line of the AnL of the IAN represented the actual AnLL.

The author also found that the mean AnLL was longer as age increased. In contrast, Kheir and Sheikhi[5] found that the AnLL did not change as age increased. However, the present study may not suffice to conclude the age-related differences as the sample size was unequal in each age group.

Limitation: CBCT with slice thickness of 0.25mm was used. Smaller slice intervals could reduce measurement errors.

Conclusion

- There were no significant differences when comparing the mean AnLL between different sides of the mandible. Thus, it can be deduced that the AnLs of the IAN are symmetrical.
- Overall, AnLL ranged between 3.04 and 9.63mm, which revealed high anatomical variation. Thus, a 3-D scan is recommended to visualise the AnL of the IAN[1] before placing implants in the region of the mental foramen.

References

1. Juan D, Grageda E, Crespo S. Anterior loop of the inferior alveolar nerve: Averages and prevalence based on CT scans. The Journal of Prosthetic Dentistry. 2016;115(2):156-160.
2. Emami E, Feine J. Mandibular implant prostheses. 1st ed. Springer International Publishing; 2018.
3. Chen J, Lin L, Geist J, Chen J, Chen C, Chen Y. A retrospective comparison of the location and diameter of the inferior alveolar canal at the mental foramen and length of the anterior loop between American and Taiwanese cohorts using CBCT. Surgical and Radiologic Anatomy. 2012;35(1):11-18.
4. Wong S, Patil P. Measuring anterior loop length of the inferior alveolar nerve to estimate safe zone in implant planning: A CBCT study in a Malaysian population. The Journal of Prosthetic Dentistry. 2018;120(2):210-213.
5. Kheir M, Sheikhi M. Assessment of the anterior loop of mental nerve in an Iranian population using cone beam computed tomography scan. Dental Research Journal. 2017;14(6):418-422.