

## Anthropometric study on inter-mental foramina distance of Myanmar populace: A Pilot Study

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### Abstract

All-on-4 implant procedure is one of the widely used procedures for oral rehabilitation of the edentulous mandible patients in which four implants are placed in the anterior mandible between two mental foramina. The two anterior implants are placed axially and the two posterior implants are placed distally tilted up to 45 degree. Tilting of the distal implants enables the placement of longer implants with increased bone-to-implant contact, improved distribution of load with shorter cantilever arm, improved inter implant distance and improved anchorage in the better-quality anterior bone. Damaging the mental nerves can also be avoided. Thus, determining inter-mental foramina distance (IMFD) is essential for proper implant planning and prosthesis design especially for All-on-4 treatment. The information on this distance of the locals may enable the dentist to safely use the universal surgical guide for All-on-4 procedure or to consider construction of specific guide for Myanmar patients. So, the objective of the study was to evaluate the inter-mental foramina distance (IMFD) of the mandible of the Myanmar populace. Retrospective observational study was conducted. CBCT images of 39 males and 39 females (total 78) were collected from archives of two imaging centers. The distance between the most mesial margins of the mental foramina were measured along the midline of the mandible in axial view. In statistical analysis, unpaired t test was used for different genders and one-way ANOVA was used for different age groups. Mean inter-mental foramina distance were 42.89 mm, 44.19 mm, 44.76 mm, 44.94 mm for  $\leq 20$  years, 21-40 years, 41- 59 years,  $\geq 60$  years age groups respectively, and 44.57mm, 43.61 mm for male, female group respectively. There was no statistically significant difference between the above groups ( $p > 0.05$ ). The inter-mental foramina distance in the study populace was such that All-on-4 universal surgical guide can be safely applied for implant surgical procedure.

Keywords: All-on-4, edentulous, implant, mental foramen

### Introduction

Prosthetic rehabilitation of edentulous mandible with dental implants has become one of the most predictable and successful treatment options nowadays. The dental implant has been shown to be very successful in obtaining the support, retention, and stability of a fixed or removable mandibular prosthesis.

The implant placement has been needed possibly by all edentulous patients because of continued bone loss after tooth loss and associated compromises in esthetics, function, and health [1]. Complaints of taking long time to get used to it, affecting speech and masticatory function because of much denture bearing area, being prone to mouth infection, looseness of denture due to rapid bone resorption and reduced

ease of use are usually seen in patients with a conventional removal prosthesis. Compared to conventional complete denture, oral function and quality of life in patients with edentulous jaws can be more effectively improved by using dental implants. Therefore, implant-supported or implant-retained removable or fixed prostheses have been gaining popularity [2].

The placement of four or six implant fixtures between mental foramen and distal cantilever of each side to replace the posterior teeth was the treatment of choice for edentulous mandible for clinical reports from 1967 to 1981 with the Branemark system [1,3]. Immediate loading procedures for edentulous jaws have become widely popular among clinicians as well as among patients. Immediate fabrication of final prosthesis on two tilted and two straight implants in edentulous jaw was safe and was not associated with higher marginal bone loss as compared to delayed loading protocol [4]. High survival rates and a low incidence of complications demonstrate the predictability of implant treatment. Soto-Penalzo et al. documented in a systematic review, a survival rate of implant over 24 months was 99.8% [5]. High survival rate (93% at patient level and 98% at implant level) after 5 years of follow-up was reported by Paulo Mao et al[6].

In some cases of problems with inadequate bone support and anatomical structures present at the implant placement site, implant prosthesis treatment is almost impossible without complex techniques such as nerve transportation and bone grafting in posterior jaws. Considerable ingenuity has been used to overcome the problems. By tilting the distal implants of All-on-4 procedure which is the full-arch rehabilitation with only four implants, the necessities for complex procedure such as bone grafting can be reduced. The protocol uses four implants in the anterior part of

complete edentulous jaws to support a provisional, fixed and immediately loaded prosthesis. The two most anterior implants are placed axially, whereas the two posterior implants are placed distally angled up to 30-45 degree anterior to the maxillary antrum in maxilla and anterior to the mental foramen in mandible. This allows the application of prostheses with up to 12 teeth [6,7,8]. By tilting distal implants in edentulous arches, the placement of longer implants with increased bone-to-implant contact, improved distribution of load with shorter cantilever arm, improved inter-implant distance and improved anchorage in better quality anterior bone can be achieved. This also helps avoiding anatomical structures. When used in the mandible, good bone anchorage can be achieved without interfering with mental foramina [6,7,8]. However, the knowledge on inter-mental foramina distance is very crucial for the safe and successful All-on-4 procedure. In this procedure, a specific surgical guide is used to place four implants between two mental foramina for mandible. This assists in ensuring the placement of the implants with correct positioning, angulation and emergence. The guide is placed into a 2 mm osteotomy that is made in the midline position of the maxilla or mandible and titanium band is contoured to follow the arc of the opposing arch. The vertical lines on the guide are used as a reference for drilling at correct angulation, which should not be greater than 45 degree [6,7]. But the surgical guide is invented according to the anthropometry of the other population. So, it is intriguing whether there is any difference in inter-mental foramina distance between Myanmar population and other populations, between different gender and between different age groups. Therefore, the purpose of this anthropometric study was to measure the inter-mental foramina distance of Myanmar population and to confirm whether the already created surgical guide can be safely used on Myanmar populace

or the guide will be needed to modify by using the results of the study.

## Materials and Methods

Ethical approval was obtained from Research and Ethic Committee, University of Dental Medicine Mandalay. Cone Beam Computed Tomography (CBCT) images of 78 people with 39 males and 39 females which were collected from two archives of imaging centers, were analyzed with the InVivo Dental viewer software (Anatomage, Santa Clara, California). Inclusion criteria for the study was such that the mental foramina of the mandible must be completely visible in the axial view of the CBCT images. The images which showed incomplete mental foramen or only a section of the mandible were excluded from the study. During the study, the distances between the most mesial margin of the mental foramina were measured along the mandible in the axial view with the software. To reduce the human error in the measurement, five labiolingual straight lines were drawn across the mandible such as two lines at the mesial margins of both mental foramina, one in the midline of the mandible and two lines in between mesial margins and the midline of the mandible according to curvature of the anterior mandible. The midpoints of these five lines were connected antero-posteriorly (figure 1). Hence, the line joining the midpoints of labiolingual lines represents the actual distance between the two mental foramina of the mandible (figure 2).

### Statistical analysis

Analysis of the inter-mental foramina distance was done between different gender and between various age group.  $p < 0.05$  was considered statistically significant. In the first analysis, unpaired t test was used for different genders and the inter-mental foramina distances of 39 males and 39 females were analyzed. For

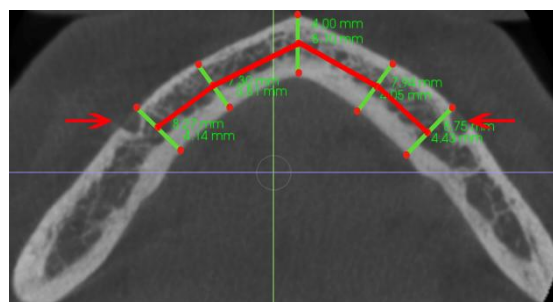


Figure 1. Radiographic image of the mandible in axial view showing how the reference lines were drawn before the measurement was made. Red arrows denote mental foramina

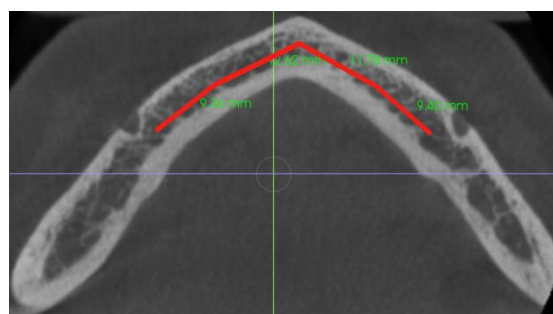


Figure 2. Radiographic image of the mandible in axial view showing the representative line for the measurement of inter-mental foramina distance of anterior mandible

the second one, One-way ANOVA was used for analysis between various age groups which are (1)  $\leq 20$  years of age ( $n=21$ ), (2) 21-40 years of age ( $n=25$ ), (3) 41-59 years of age ( $n=25$ ), (4)  $\geq 60$  years of age ( $n=7$ ).

The collected data were cleansed and entered in Statistical Package for the Social Sciences (SPSS) (Version 22.0) and analyzed. The continuous variables were expressed by the means and standard deviations (Mean  $\pm$  S.D) and analyzed by one way ANOVA.

## Results

The CBCT analysis of 78 images showed that the mean inter-mental foramina distances were  $44.57 \pm 3.26$  mm for males and  $43.61 \pm 3.34$  mm for females (figure 3) while the mean distances were  $42.89 \pm 3.42$  mm,  $44.19$

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$\pm 3.21$  mm,  $44.76 \pm 3.56$  mm and  $44.94 \pm 1.92$  mm for various age groups of  $\leq 20$  years, 21-40 years, 41-59 years and  $\geq 60$  years respectively (figure 4). The statistical analysis showed there was no significant difference between male and female as well as between different age groups ( $p > 0.05$ ).

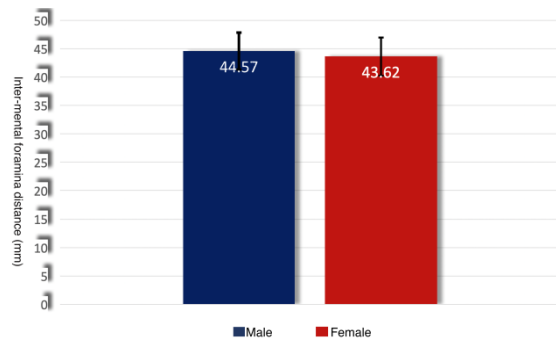


Figure 3. Bar chart showing mean inter-mental foramina distances of male and female groups,  $p > 0.05$

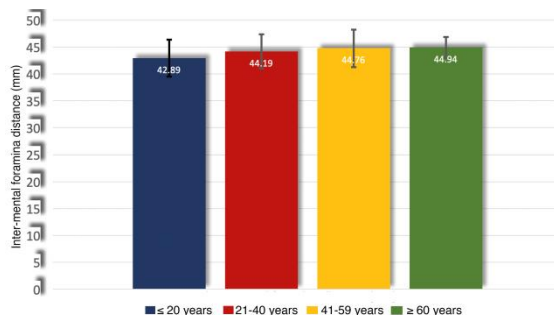


Figure 4. Bar chart showing mean inter-mental foramina distances of various age groups

### Discussion

The evaluation of the location of mental foramen is one of the essential preoperative assessments in many dental surgical interventions carried out in mandible such as tooth extraction, periodontal surgery, implant placement, etc. Due to this fact, there are many researches which were conducted on various nationalities to determine the location of mental foramen in relation to mandibular teeth, tridimensional borders

of mandible and other vital anatomical parts of mandible.

Nevertheless, those studies were carried out on nationalities other than Myanmar populace and as a result, the data which concerns with the location of the mental foramina of the mandible of the people in Myanmar is still lacking. Therefore, the present anthropometric study was conducted to determine the inter-mental foramina distance in Myanmar Population by emphasizing on the aspect of implantology especially the All-On-4 implant placement. In All-on-4 procedure, the goal is to have largest possible anterior-posterior distribution between anterior & posterior implants for better survival of implants and prostheses [9]. The limitation of the posterior extension of the distal implant is the presence of mental foramina [9]. For the purpose of increasing the antero-posterior distribution and limiting the cantilever arms of the prosthesis, tilting the two posterior implants distally to the mental foramen is considered to place the platforms of them as posteriorly as possible [9]. This also helps avoid nerve injury in case of the presence of anterior loop of Inferior alveolar nerve and allows the placement of longer implants.

The locations of mental foramina were determined by researchers in cadaveric specimens, panoramic radiographs and CBCTs. However lineal measurements using panoramic radiographs are not precise and not adequate to identify the mental foramina because of superimposition of anatomical structures and magnifying distortions [10]. The accuracy of CBCT for 3D analysis and linear measurements of maxillofacial bones have been confirmed by several studies. It is also widely acknowledged that the information provided surpasses the risks associated with the radiation doses typically absorbed [10]. Therefore, CBCT images were collected in this study to measure the inter-mental foramina

distances. Additionally, inter-mental foramina distance was measured along the mid points of width of mandible to make the length coincide with the position of implants placement as close as practically possible.

According to different measurement methods, the results obtained in the present study may not be comparable to others in an exact manner. Al-Juboori et al examined 393 OPG images and the average inter-mental foramina distance for total Malaysian population was  $55.47 \pm 8.76$  mm [11]. In their study, the length was obtained by drawing horizontal line on transparent paper from most medial aspect of the mental foramen to midline which is measured and corrected for magnification errors. There was no relationship between ethnicity (Malay, Chinese and Indian) and inter-mental foramina distance [11].

Neiva et al reported that the mean length of straight line measured in 22 Caucasian skulls from most medial aspect of each mental foramen to contralateral mental foramen was  $55.23 \pm 5.34$  mm (range: 46 to 62 mm) [12]. In the cadaveric study by Udhaya et al on the South Indian population, the average distances of the right mental foramen to the midline were  $25.7 \pm 1.78$  mm and  $25.29 \pm 2.29$  mm on right and left sides respectively [13]. The values observed in the cadaveric study on Chinese population conducted by Wang et al were  $28.12 \pm 1.86$  mm on the right side and  $27.99 \pm 1.86$  mm on the left side [14].

According to referred studies, it seems that there is no single and universal pattern of inter-mental foramina distance in different populations. For Myanmar population, the present study is the first one conducted to measure the inter-mental foramina distance. The mean inter-mental foramina distances were  $44.57 \pm 3.26$  mm for males and  $43.61 \pm 3.34$  mm for females.

The universal surgical guide which was created according to anthropometry of other population has been used in All-On-4 implant placement. The information on the inter-mental foramina distance of Myanmar locals may enable the dentists not only to safely use the universal surgical guide for All-on-4 procedure but also to consider construction of specific guide which best suits Myanmar patients by modifying scales of guiding lines on surgical guide.

#### Limitation of the study and future research

Sample size of the study was only 78 and the imaging centers are located in the same demographic area. Therefore, the sample size and the distribution in this study are not adequate enough for the representation of the entire nation. Further study with higher sample size and better distribution over the entire nation is recommended to represent the whole population in the country.

#### Conclusion

Within the limitations of the study, the measured inter-mental foramina distance of Myanmar population allows the all-on-4 surgical guide to be used safely in all-on-4 implant placement surgical procedures.

#### References

1. Resnik R. Misch's Contemporary Implant Dentistry. 4<sup>th</sup> ed. Mosby; 2020.
2. Liu X, Pang F, Li Y et al. Effects of different positions and angles of implants in maxillary edentulous jaw on surrounding bone stress under dynamic loading: a three-dimensional finite element analysis. *Comput Math Methods Med*. 2019; 2019: 8074096.

3. Brånemark PI, Engstrand P, Ohnrell LO, A new treatment concept for rehabilitation of the edentulous mandible. Preliminary results from a prospective clinical follow-up study. *Clin Implant Dent Relat Res.* 1999;1(1):2–16.
4. Najafi H, Siadat H, Akabari S, Rokn A. Effects of immediate and delayed loading on the outcomes of all-on-4 treatment: a prospective Study. *J Dent (Tehran).* 2016; 13(6):415-422.
5. Soto-Penaloza D, Zaragozí-Alonso R, Penarrocha-Diago M, Penarrocha-Diago M. The all-on-four treatment concept: systematic review. *J Clin Exp Dent.* 2017; 9(3):e474-88.
6. Malo P, Nobre MA, lopes A, Francischone C, Rigolizzo. All-on-4 immediate function concept for completely edentulous maxillae: a clinical report on the medium (3 years) and long term (5 years) outcome. *Clin Implant Dent Rel Res.* 2012; 14(suppl):e139-148.
7. Taruna M, Chittaranjan B, Sudheer N, Tella S, Abusaad MD. Prosthodontic perspective to all-on-4 concept for dental implants. *J Clin Diagn Res.* 2014;8(10):ZE16-ZE19.
8. Anandh B, Lokesh B, Ebenezer V, Jimson S, Parthiban J. All on Four - the basics. *Biomed Pharmacol J.* 2015; 8(spl.Edn):609-612.
9. Weir, D. Implant treatment planning for the edentulous patient: a graftless approach to immediate loading. *Br Dent J* **211**, 298 (2011).
10. Velasco-Torres M, Padial-Molina M, Avila-Oritz G, Garcia-Delgado R, Ca-tena A, Gallindo-Moreno P. Inferior alveolar nerve trajectory, mental foramen location and incidence of mental nerve anterior loop. *Med Oral Patol Oral Cir Bucal.* 2017 Sep 1;22(5):e630-5.
11. Al-Juboori MJ, Saini R, Al-wakeel HA, Fang LY, Eirutharajan N, Balachandran SA. Evaluation of the intermental foramina distance among Malaysian population by using orthopantomogram radiograph. *Int J Exp Dent Sci.* 2016;5(2):118-122.
12. Neiva RF, Gapski R, Wang HL. Morphometric analysis of implant-related anatomy in Caucasians skulls. *J periodontol.* 2004 Aug;75(8):1061-1067.
13. Udhaya K, Saraladevi KV, Sridhar J. The morphometric analysis of the mental foramen in adult dry human mandibles: a study on the south indian population. *J Clin Diagn Res.* 2013 Aug; 7(8):1547-1551.
14. Wang TM, Shih C, Liu JC, Kuo K-J. A clinical and anatomy study of location of mental foramen in adult Chinese mandibles. *Acta Anat.* 1986;126:29-33.