Original Article

# Assessment of Location of Mental Foramen in Mandible Using Cone Beam Computerized Tomography

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**ABSTRACT:**

**Objective:** To determine the mean distance of mental foramen from the base of the mandible and mandibular symphysis in patients reporting to tertiary care center using Cone Beam Computerized Tomography (CBCT).

**Study design and setting:** Cross-Sectional Study was carried out in the Prosthodontics Department, Foundation University College of Dentistry, Islamabad from March 2019 to August 2019.

**Methodology:** Total 100 patients between the age of 20-45 years were participated. CBCT investigation was carried out and measurements of mental foramen from the base of the mandible and mandibular symphysis in patients were recorded with the help of measuring tools in the software and noted down on the performa. SPSS version 20 was used analyze the data. P value less than 0.05 was considered as statistically significant. . Frequency and percentages were calculated for variable gender (qualitative). For quantitative variables like age, distance mental foramen from the mandibular Symphysis and inferior border of mandible, mean + SD were calculated. Independent samples t-test was used to compare quantitative variables like distance MF from the mandibular symphysis/midline and inferior border of mandible. P values < 0.05 was considered as statistically significant.

**Results:** The Mean+SD distance of anterior border of mental foramen from symphysis on left and right side were 24.12+2.835 and 24.88+2.637 and from the lower border of mandible were 11.97+1.359 and 12.00+1.764 respectively.

**Conclusion:** The mean vertical and horizontal distances calculated in this study can provide a useful guide to dentist to safely place dental implants within the inter-foraminal region in our population.

**Keywords;** Cone Beam Computerized Tomography, Mandible, Mental Foramen

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## INTRODUCTION:

Mental foramen (MF) allows the passage of the terminal branch of inferior alveolar nerve (IAN) which is known as the mental nerve. It supplies sensory innervation to the soft tissues of the buccal vestibule, lower lip, and gingival soft tissue mesial to the first molar in the mandibular arch.[1]The location and emergence of this nerve have been described to vary in individuals.[2] Certain studies have suggested a variation, based on geography, gender and as well as history, in the morphology of the mental foramen and neurovascular bundle is transmitted by it.[3,4]

The area of mandible between the mental foramens is assumed to be a safe area for the insertion of dental implants and is often involved in many other surgical procedures. Therefore, it is essential to appreciate the anatomy of this region to avoid any injury to the neurovascular bundles. Sensory dysfunction occurs when the mental nerve is damaged at foraminal region.[5]The sensory dysfunction in the chin and lower lip region is one of the most inadvertently occurring complications during placement of implant in the anterior mandibular region.[6] Damage to mental nerve causes immense suffering to the affected patient leading to hypoesthesia and anesthesia as well as paresthesia and pain. Sensory discomfort adversely affects the patient's quality of life.[7]

It is therefore necessary to have a clear vision/image of the jaw to prevent these damages, which can be achieved by combination of clinical and anatomical knowledge of

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mandibular structures and with the help of findings obtained from clinical and radiological examination.[8] Thus, revisiting the anatomy of mental foramen with the 3D imaging technique, that is, Cone beam computerized tomography (CBCT), will provide a better image quality/resolution and an accurate representation of the structures with a low radiation dose.[9]

The rationale of our study is to determine the mean location of mental foramina (MF), that is, vertical and horizontal, in our population thus identifying the estimated safe zone implant placement in the inter-foraminal region thereby minimizing the chances of damage to the mental nerve.

**METHODOLOGY:**

This Cross-sectional study was carried out in the Prosthodontics Department, Foundation University College of Dentistry, Islamabad. The study duration was 06 months (March 2019 to August 2019) and a sample size of 100 patients was selected for this study, calculated with the help of WHO sample size calculator. Ethicle approval was obtained from the concerned institute No WDC/2019/1074. A Non-probability consecutive sampling technique was used for data collection. Inclusion criteria consisted of patients of both male and female gender with age ranging from 20-45 years, patients for whom CBCT has been advised as part of their treatment, patients with no history of mandibular fracture, both partially dentate and completely edentulous patients were selected and patients with no history of tumors, cyst or any other bony deformity in the mandible. Exclusion criteria consisted of patients with a history of tumors, cyst or any other bony deformity involving the anterior portion of the mandible within the region of right and left mandibular 1$^{st}$ molar or presence of any radiolucent lesion in the lower jaw in the same region, patients with any jaw growth deformity, patients with any identifiable syndrome, patients on bisphosphonate therapy, patients with osteoporosis and non-visualization of the mental foramen bilaterally.

Prior approval from Ethical Review board was taken. As a protocol all patients presenting to hospital were examined in dental OPD/ diagnostics department and patients with prosthodontic needs were referred to Prosthodontics department. Those patients who fulfilled the criteria (Exclusion and Inclusion) were selected for the study. Patients in whom CBCT was required where advised the investigation done at any nearest laboratory with the facility of this investigation. Most patients reported 3D radiographic images of the patient which were recorded using Newtom vgi CBCT (Verona, Italy). Measurements of the MF from the mandibular Symphysis and inferior border of the mandible were recorded using a measuring tool in panorex view, cross section (FIGURE-1) and 3D model (FIGURE-2) in the software (NNT viewer) provided with CBCT. The measurements recorded were filled in the Performa for each patient separately.

SPSS version 20 was used to analyze the data. For qualitative and qualitative variables descriptive statistics were calculated as frequency and percentages. For quantitative variable mean +/- SD was calculated like age, distance mental foramen from the mandibular symphysis and inferior border of mandible. Independent sample t-test was used to compare quantitative variables like distance MF from the mandibular Symphysis/midline and inferior border of mandible. P values of > 0.05 was considered significant.

**RESULTS:**

The number of patients selected for this study was n=100. Out of these 100 patients n=50 (50%) were males and n=50 (50%) were females. The Mean + SD and the frequency of age distribution of the patients have been illustrated in Figure-3. Mean + SD age of male patients was 38.82 + 5.401 and female patients was 33.92 + 6.496. Among n=100 patients, n=17 (17%) were completely edentulous and n=83 (83%) were partially dentate patients.

The Mean + SD distance of the Left Mental Forman (LMF) and Right Mental Foramen (RMF) from the mandibular symphysis/midline of all patients was 24.12+2.835 and 24.88+2.637 respectively. Whereas, mean + SD distance of LMF and RMF from the symphysis/midline in males was 24.45 + 2.29 and 24.76 + 2.47 and in females was 23.79 + 3.27 and 24.99 + 2.82 respectively.

The Mean + SD distance of LMF and RMF from the mandibular lower border in all patients was recorded to be 11.97+1.359 and 12.00+1.764 respectively. The Mean + SD distance of LMF and RMF from the mandibular lower border in males was 12.50 + 1.26 and 12.65 + 1.67 respectively. The Mean + SD distance of LMF and RMF from the mandibular lower border in females was 11.44 + 1.25 and 11.34 + 1.61 respectively.

Paired Sample T-Test was used to determine the difference between the distance on left and right side. Statistically significant difference was found between the distance of LMF and RMF from the symphysis/midline of mandible, with a p value of 0.000. There was no statistically significant difference between the distance of LMF and RMF from the lower border of mandible, with a p value of 0.826.

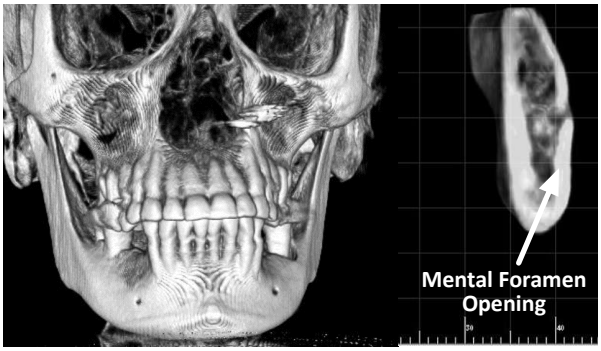
Independent Sample T-Test was used for stratification to determine the difference in distance of the mental foramen between genders. There was no statistically significant difference in the distance of LMF and RMF from the midline between males and females, with p value of 0.244 and 0.665 respectively (Table-1). Whereas statistically significant difference was found in the distance of LMF and RMF from the lower border between males and females, with p value of 0.000 and 0.000 respectively (Table-2).

Independent Sample T-Test was used for stratification to determine the difference in distance of the mental foramen between age groups (divided into 2 groups, that is, Group-

I: 20-32 years and Group-II: 33-45 years). No statistically significant difference was found in the distance of LMF from midline between the age groups with p value of 0.553. Although statistically significant difference was noted in the distance of RMF from the midline between both age groups, with p value of 0.006. Statistically significant difference was found in the distance of LMF from the lower border, with p value of 0.007. Whereas no statistically significant difference was found in the distance of RMF from the lower border, with p value of 0.357.

Figure 1: Cross-Sectional Cut at The Location of Mental Foramen with Measurement Recorded from The Level of Inferior Margin of Mental Foramen To The Base of Mandible with The Help Of Linear Measuring Tool


Figure 2: 3D Model of Patient with Cut Model At The Location of Mental Foramen With Grid Measuring Tool




**DISCUSSION:**

The precise location of the Mental Foramen (MF) is the most important aspect when considering the placement of dental implants in the anterior mandible, especially in completely edentulous patients where there is an absence of dental landmarks to guide during implant placement. Significant differences have been reported in the location of MF among different ethnic groups. Igbigbi et al. in

Figure 3: Bar Chart Illustrating Frequency of Age Distribution of Patients

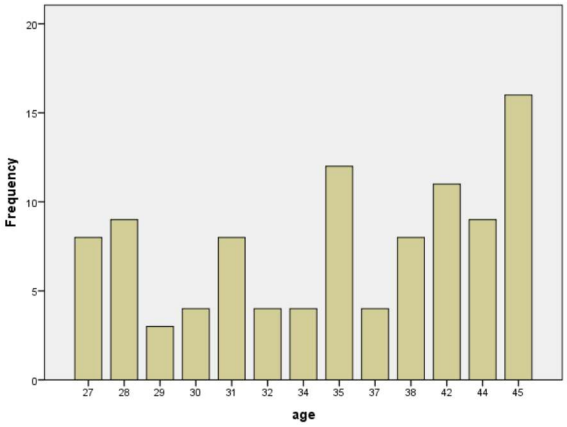



Table 1: Stratification Of Mean Distance Of Mental Foramen On Left And Right Side From The Mandibular Midline With Regards To Gender

| Gender | Distance of Left Mental Foramen from Mandibular Midline (mm) | | P Value (Independent Sample T-Test) |
|---|---|---|---|
| | n | Mean + SD | |
| Male | 50 | 24.45 + 2.29 | 0.244 |
| Female | 50 | 23.79 + 3.27 | |
| Distance of Right Mental Foramen from Mandibular Midline (mm) | | | |
| | n | Mean + SD | |
| Male | 50 | 12.65 + 1.67 | 0.655 |
| Female | 50 | 11.34 + 1.61 | |

Table 2: Stratification Of Mean Distance Of Mental Foramen On Left And Right Side From Lower Border Of Mandible With Regards To Gender

| Gender | Distance of Left Mental Foramen from Lower border of Mandible (mm) | | P Value (Independent Sample T-Test) |
|---|---|---|---|
| | n | Mean + SD | |
| Male | 50 | 12.50 + 1.26 | 0.00 |
| Female | 50 | 11.44 + 1.25 | |
| Distance of Right Mental Foramen from Lower border of Mandible (mm) | | | |
| | n | Mean + SD | |
| Male | 50 | 12.65 + 1.67 | 0.00 |
| Female | 50 | 11.34 + 1.61 | |

Malawians and Mbajiorgu et al.[10,11] in Zimbabweans mandibles reported that the commonest position for (MF) was along the roots of 2nd premolar tooth followed by between the roots of 1st premolar and 1st molar teeth.[11] However, Santini and colleagues in British and Green in Chinese mandibles observed that the most common position for MF was between the roots of 1st premolar and 2nd premolar teeth followed by along the roots of 2nd premolar tooth.[12,13] In other studies on Kenyan population the most common position of MF was found to be between the roots of 1st premolar and 2nd premolar teeth followed by along the long axis of 1st premolar tooth.[14] In Malay mandibles the most common position was along the roots of 2nd premolar tooth followed by between the roots of 1st premolar and 2nd premolar teeth.[15] In all of the above-mentioned studies the mental foramen on right and left sides were not considered separate from each other rather they were considered as the same. Another drawback or limitation in the above-mentioned studies had in common was that they used teeth to identify the position of the mental foramen relative to them, which therefore is of little if any or no help when it comes to implant therapy in completely edentulous patients. The position of the teeth in itself is variable and not everyone has perfectly aligned teeth thus in cases of malocclusion, this relative positioning would again be of no help.

In our study; measurements from specific hard tissue landmarks were used to determine the position of mental foramen in our population. These landmarks are stable and do not change whether the individual is dentate or edentulous thus giving much more accurate location of mental MF.[16] in our study the landmarks used where distance of anterior border of MF from midline/ symphysis of mandible and distance of lower border of MF from the lower border of the mandible. In a study conducted by Budhiraja and colleagues to determine the position of MF in the North Indian population same landmarks were used.[4] They considered the location of LMF and RMF separately which is in accordance with our study. According to their study Mean+SD distance of anterior border of MF from symphysis on left and right side were 25.29+0.30 and 25.39+0.66 respectively.[4] These measurements are different from that recorded in our population, that is, 24.12+2.835 and 24.88+2.637 on left and right side respectively. In the same way Mean+SD distance of lower border of MF from the lower border of mandible recorded by Budhiraja et al. were 15.40+0.22 and 15.25+0.24 on left and right side respectively.[4] In our study the Mean+SD distance of MF on left and right side from the lower border were 11.97+1.359 and 12.00+1.764 respectively. These measurements along with other studies show that there is difference in the distance/ position of MF based on ethnicity. Thus, ethnic group should be included in the process of recording history of a patient while selection for dental implant in completely edentulous patient in this region.

In another study conducted by Rashid and colleagues it was found that there was statistically significant difference in the vertical position of MF between males and females.[17] In our study no significant difference was found between males and females in the location of MF. In the same study the authors found that there was no statistically significant difference between the distance of MF from the lower border on the left and right side which is in accordance with our study regarding the vertical position of mental foramen. In a study conducted by Singh and colleague on the position of MF there was significant difference in the distance of MF from the symphysis on the left and right side which is in accordance with our study.[18] Rashid and colleagues also found that there is significant difference in the measurement of mental foramen with that of age with a p value of <0.001.[17] This finding is in accordance with our study.

Variation in the site of MF may also be related to diverse feeding habits thus altering the development of mandibule.[19] Erstwhile clinical knowledge of common sites in local populations may be helpful in effective nerve blocks and surgical procedures. Furthermore, age of the person is related with the difference in position of mental foramina. The differences observed among some studies may also be related to the difference in research methodology, such as measurements recorded on skull or use of different skull marks or photographs — inferior margin versus center or anterior margin of MF. [20,21]

One of the limitations in our study was that we did not take into account the variation in the shape of MF. Numerous variations in the shape of mental have been reported in literature.[11-14] These shapes vary in form from round to oval and other variations. The shape of the MF can also have an influence on the dental implant placement in a completely edentulous patient for prosthetic rehabilitation in the region of MF.[7] This position is crucial for dental implant placement in cases where only 2 implants have to be provided for the replacement of missing teeth in the form of implant supported overdenture. If the location of mental foramen is such that it limits the placement of dental implants in this location the design of the prosthesis as well as implant position and dimensions might also need to be changed.[22] Another limitation was that the size of foramen was also not taken into consideration for our study, though it would have had little effect on the results of current study.[14] Lastly the direction of opening of the foramen and any accessory foramina were also not taken into account for our study.[18] Within the limitations of this study, it is concluded that localization of MF in its various positions is vital for dental surgeons to avoid damage to neurovascular bundle. . Variations do exist in the position of mental foramen in different population groups although the mean vertical and horizontal distances calculated in this study can provide a useful guide to dentist to safely place dental implants within the inter-foraminal region in our population. Further studies

on larger population may be required to better estimate the location of mental foramen

**CONCLUSION:**

The mean vertical and horizontal distances calculated in this study can provide a useful guide to dentist to safely place dental implants within the inter-foraminal region in our population.

**Author Contribution:**
Shoaib Rahim: Original idea of research, data collection, statistics
Maria Shakoor Abbasi: Statistics, Literature Review
Ali Waqar Qureshi: Statistics, Literature Review
Ammarah Afreen: Data Collection, Literature Review
Zarah Afreen: Data Collection, Literature Review
Atikah Saghir: Literature Review

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