Pre –treatment implant CBCT Analysis of Anterior Mental Loop Length, Lingual Concavity and Inclination of Alveolar Ridge in the Mandible – A UAE Study

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Abstract

Aims: This study aims to use 3D imaging (CBCT) in order to identify the presence of anterior mental loop, know its dimensions and variation in anatomy, lingual concavity and the angle of tilt in the mandibular ridge aiding in better treatment planning for surgical approaches.

Method: Forty CBCT images of patients scanned by Planmeca Romexis for different diagnostic purposes, were analyzed using the Romexis software.

Results: The study results showed that mental loop was present in 62.5% of patients on the right side and 70% of patients on the left side, with a mean length ranging from 0.30 mm to 3.12 mm. The presence of anterior canal was observed in 5 patients (2 Females and 3 Males) 12.5% of the cases examined. As mentioned in methodology lingual concavity was classified based on its morphology into three classifications: A (Acute undercut) B (stream line) C (Kidney shape), with class C (Kidney shape) amounting up to 42.5% of the cases while the least common was class B (stream line). In 40% of the cases, deepest lingual concavity was in the region of the second molar.

Conclusions: Placement of implants in the molar region of the mandible may result in perforation of the lingual cortex due to severely inclined ridge or deep lingual concavity. Presence of mental loop and anterior mandibular canal in the region of mandibular region needs careful evaluation using different tomographic slices.

***Key words**: Mental loop, Lingual concavity, CBCT, Mandibular ridge inclination.*

Introduction

With the latest advancement in the dental imaging, it is legally mandatory to have a complete knowledge about the anatomy of the ridge prior to performing an implant surgery or any surgical procedure. Thorough information about the location, tilt type of the lingual concavity and the mental loop is a boon for the clinicians to avoid any surgical mishaps.

The inferior alveolar nerve curves up and in most of the cases traverses for some millimeters anterior to the mental foramen and then return back to exit as the mental foramen, which is called as the anterior loop.[7] Bifid canals and anterior extension of the loops of this pathway or route are commonly seen. In such variations procedures like osteotomy or implant placement might result in paresthesia and hemorrhage due to violation of critical anatomical structures.[8]

The information about the safe distance, the location, and the amount of looping of inferior alveolar canal is quite critical and needs detailed investigations. Due to the limitations of conventional examination methods like clinical examination such as probing or 2D image radiography, cone beam computed tomography is one of the most accurate methods to have such detailed information and readings. CBCT helps in preoperative investigation and surgical planning. It is even used in intraoperative observation for more successful results and avoidance of many complications postoperatively.[2]

It was observed that 50% of the radiographically detected anterior loops of the mental canal were misread with panoramic radiograph, and 62% of the anatomically identified loops were not detected radiographically. It was concluded that panoramic radiograph images are undependable and have high numbers of false-positives and false-negative results in identifying the anterior loop.[4]

It is really important to know the angulation of the hand piece during osteotomy to avoid perforation of the lingual concavity and any violation to the mental foramen. The use of CBCT as a preoperative investigation aids in minimizing the complications as it helps in knowing the degree of angulation needed while performing the osteotomy.[3]

In a study conducted by Sahman et al it was shown that almost in 30% of the patients were detected with anterior loop of the mental nerve. The study also concluded that CBCT image prior to surgical implants procedure is a mandatory pre-operative examination in order to identify the presence of the anterior mental loop.[9]. In another study, conducted in Saudi Arabia, results have shown that more than half of mental foramens studied were located below the apex of second premolar while only 30% were between the first and the second premolar's apices.[1] The morphology of the lingual concavity was classified into 3 types: Convex ©, Parallel (P) and Undercut (U). the classification was done based on the shape of the mandible ridge and the presence of the concavity. The undercut shape was found in more than half of the study samples. Planning for implants in the mandibular first molar region was reinforced by the detection of the lingual concavity, its location and shape.[3]

In another retrospective study, both dentulous and edentulous cross-sectioned 3D images of patients were analyzed to see the morphology of lingual undercuts classifying it into U (undercut), P (parallel), and C (Convex). Their results showed that more than half of the cases presented with lingual concavity and 90% of it was in the second molar area.[5]

2. Materials and methods.

This retrospective cross-sectional study was conducted on 40 CBCT scans of patients treated at or referred to Ajman university clinics, Fujairah campus. All images were analyzed using the same CBCT Planmeca Romexis 3D software version 4.2.0 in High resolution mode. The exposure settings: 90 KVp, 6.3 mA, 12 seconds time, 8x8 cm field of view, and 0.200 mm voxel size. Population of the study was CBCT archived Images of 40 patients. Ethical committee approval was obtained from Ajman University ethical committee.

2.1 Inclusion criteria:

1.All the CBCT images in Ajman university server with good quality and good radiographic contrast, and density.

2.Images of dentate patients (18 to 60 years old) without any signs of bone loss in the crestal area

2.2 Exclusion criteria:

1. Any CBCT image involving bone loss in the mental foramen region.

2. Any CBCT image of patient with pathology causing bone loss in the region.

3. Any CBCT image where the mental region is not clearly defined due to metal artifacts or noise from the fillings.

Descriptive Statistical analysis was performed on 40 patients in both right and left sides of lower jaw (80 nos: in total) using IBM SPSS statistics viewer. Chi square test and cross tabulation test was done at 0.1 significant level to check the correlation of anterior loop length with age and gender of the patients on both right and left side.

Same tests were used to check for the correlation between lingual concavity with gender and age of the patients. The procedure was performed as follows: CBCT images are evaluated from the software. Axial, coronal and sagittal sections are evaluated for mental loop location. Distance between convexity of the mental loop and anterior border of the mental foramen is measured in axial view (Figure No. 1). Most concaved area in the lingual plate of the mandible is identified in implants view of Romexis software. The degree of the ridge inclination to the labial cortex is measured in the most concaved coronal section in implants view. The degree of concavity angle was measured using implant coronal view. (Figure No. 2) The morphology of lingual concavity was traced using trace paper on an image of sectioned implant view with the most concaved region. This is to classify different types of concavity, lingual concavity and are classified into three classifications: (Figure 3)

Class A: Acute undercut Class B: Stream line Class C: Kidney shape.

We analyzed the presence of anterior extension of the canal in axial sections. (Figure 4) Measuring the angle of ridge inclination was done, using the flush terminal on the buccal shelf and the axis of inclination of the alveolar ridge. Grading of the mandibular ridge inclination done based on the degree of angulations as follows:

Grade I: 5° - 10°

Grade II: 11° - 15°

Grade III: 16° - 20°

Grade IV: 21° - 25°

Grade V: 26° - 30°

Measuring the angle of the depth of lingual concavity Grading of the degree of lingual concavity done based on the angle of depth of the concavity as follows and it was done measuring the flush terminal plane producing the depth of lingual concavity.

Grade I: 100° - 120 °

Grade II: 121° - 140 °

Grade III: 141° - 160°

Grade IV: 161° - 180°

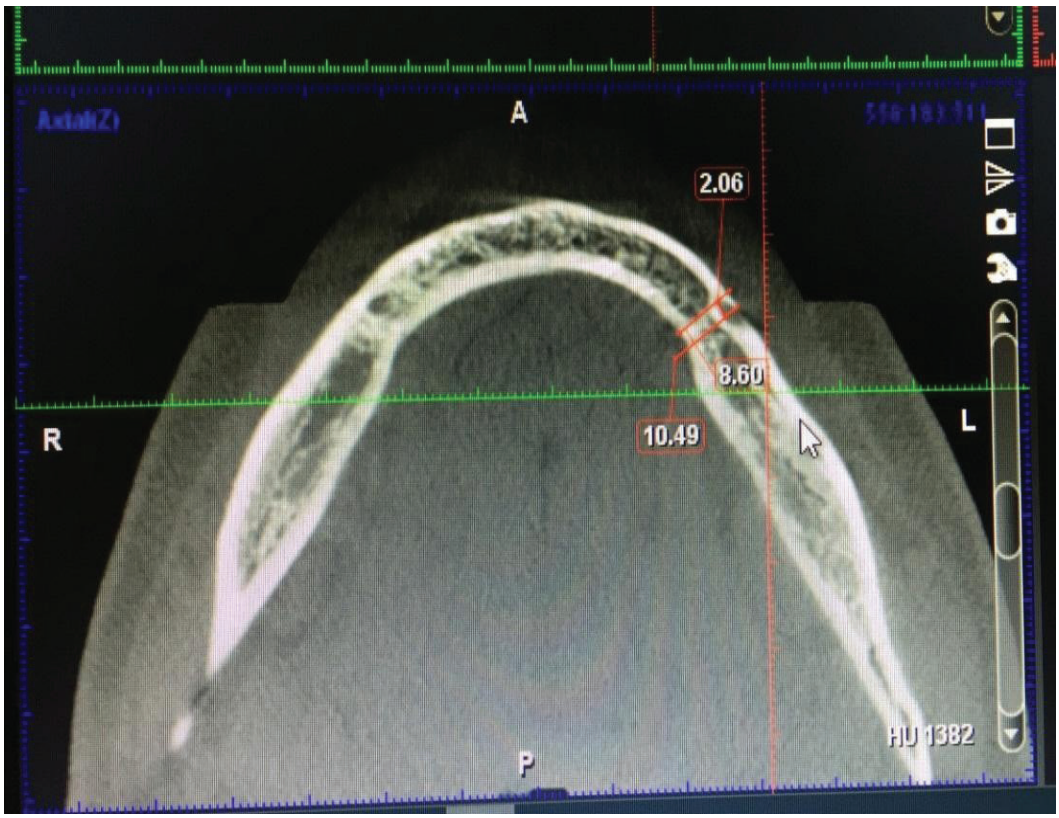
Results

The mental loop length of the mental foramen was measured in all 40 patients on both right and left sides, and in those patients evaluated, mental loop was identified in 62.5% of patients on the right side and 70% of patients on the left side. Mean length of mental loop in females is 0.871mm with SD of 0.54642 while in Males is 1.1034 mm with SD of 0.76803. It clearly shows that male patients are having a higher mean mental loop distance measurements compared to female patients. In the right side 2.5 % of the cases present with 1 mm length of anterior loop and 5 % of the cases with 2 mm anterior loop length, while on the left side anterior loop length of 1 mm was present in 7.5% of the cases and 12.5 % of them present with 2 mm loop length. The longest mental loop length observed was 3.12 mm in length and was seen in a male patient. In 20% of the cases the absence of the anterior mental loop was bilateral, unilateral absence of the loop on the right side is 37.5% of the cases, while on the left side unilateral absence of the loop was in 30% of the cases. Thus clinically 1/3rd of the cases were showing either right or left unilateral absence of mental loop.At $\alpha = 0.1$ There is no statically significant correlation between the presence and absence of the mental loop and gender or age of the patients. Association between the length of the loop with either the age of the patient or the gender of the patients was not statistically significant (P value = 0.536) as shown in (Graph 1, Table 1)

As mentioned in methodology lingual concavity was classified based on its morphology into three classifications: A (Acute undercut) B (stream line) C (Kidney shape), the most common class was class C (Kidney shape) in both right and left sides represented in 42.5% of the cases while the least common was class B (stream line) expressed in 17.5% on the right side and 20% on the left side. At $\alpha = 0.1$ It was observed that there is significant correlation between lingual concavity on the right side and left side for both females and males with age. (F: r = 0.44, P value = 0.087) (M: r = 0.494, P value = 0.019). (Graph 2 & 3) Maximal depth of the lingual concavity was commonly seen in the Mandibular second molar region (40% on the right and 47.5% on the

left side), while the least common region to have lingual concavity was observed in the third molar region. Angle of the depth of lingual concavity was commonly ranging from 141°- 160° (Grade III) in 60% of cases on the right side and in 65% on the left side. 45 % of the total cases on the right side present with inclination of the alveolar ridge with reference to buccal cortical plate in a range from 11° to 15° (Grade II) and 40 % of the cases on the left side present with ridge inclination with reference to buccal cortical plate from 16 to 20°(Grade III).

		Mean ALL	**Age**
	Pearson	1	.101
	Correlation		
Mean ALL	Sig. (2-tailed)		.536
	N	40	40
	Pearson	.101	1
	Correlation		
Age	Sig. (2-tailed)	.536	
	N	40	40



Figures 1 Measurement of mental loop in the axial section

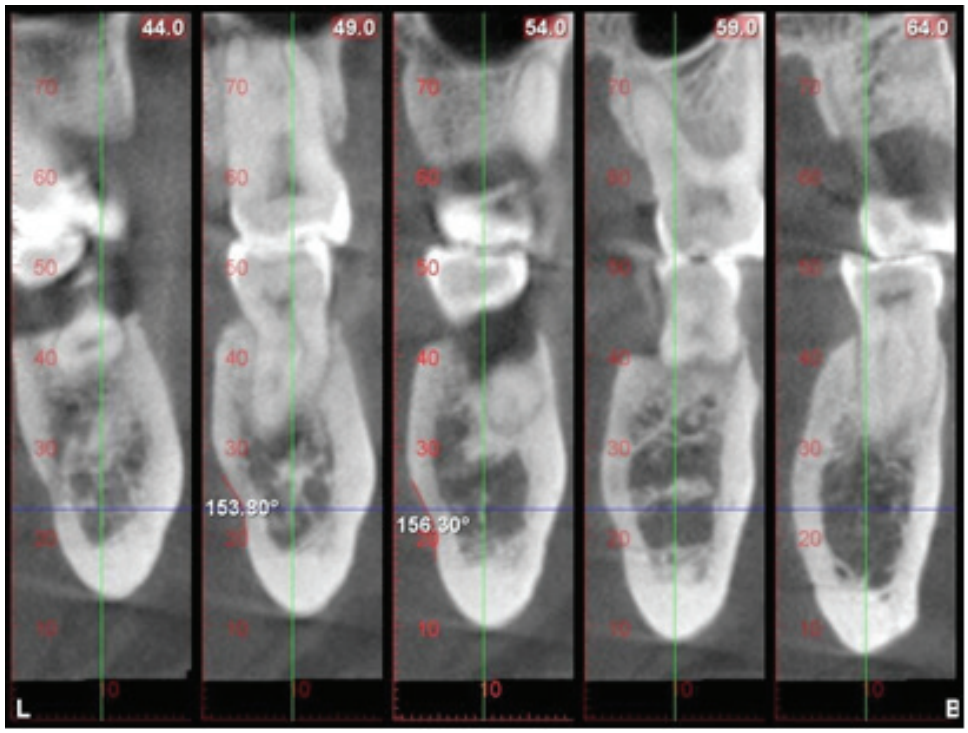


Figure 2 Lingual concavity measurement in the coronal implant view.

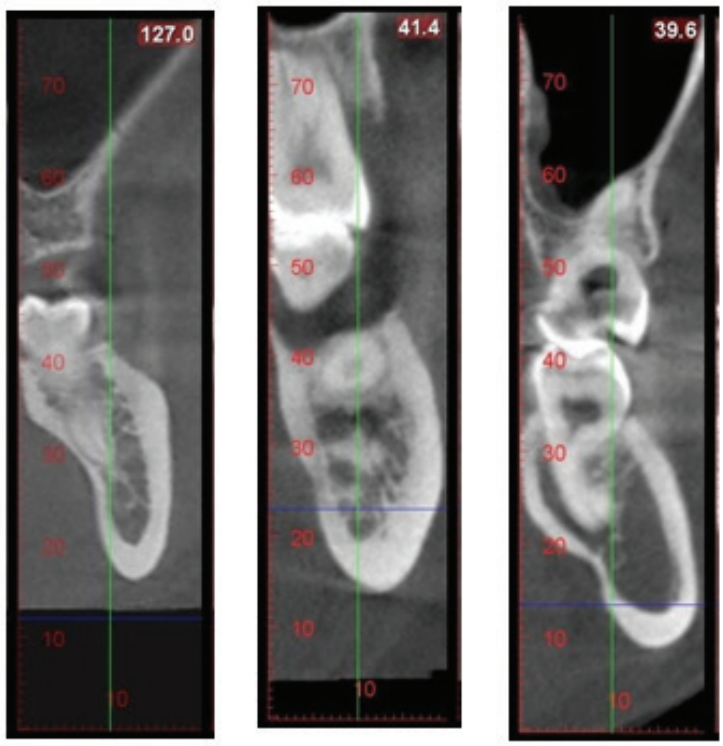


Figure No. 3 Morphological classification /Biotypes.

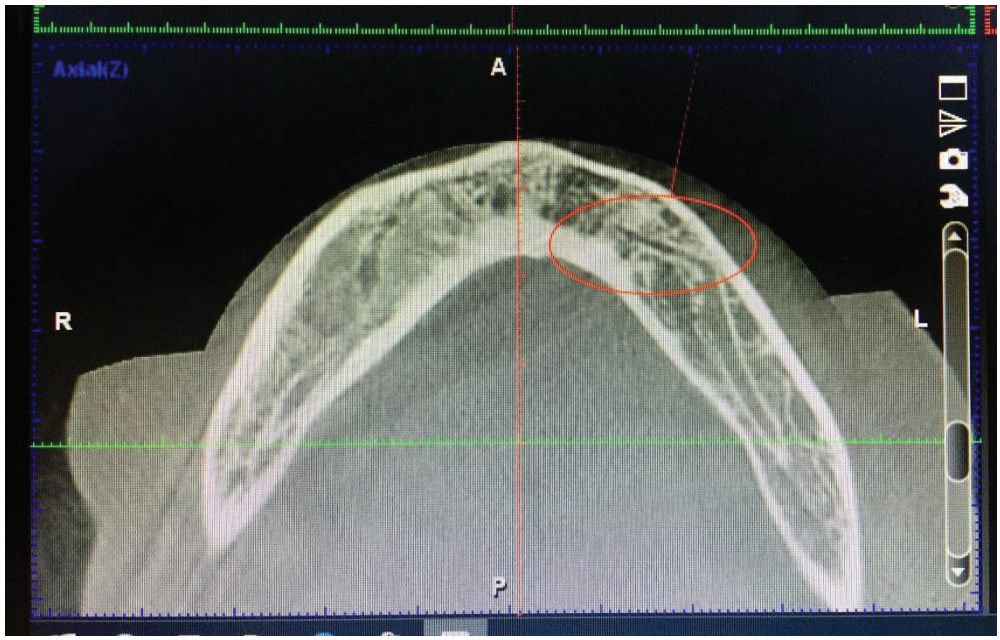
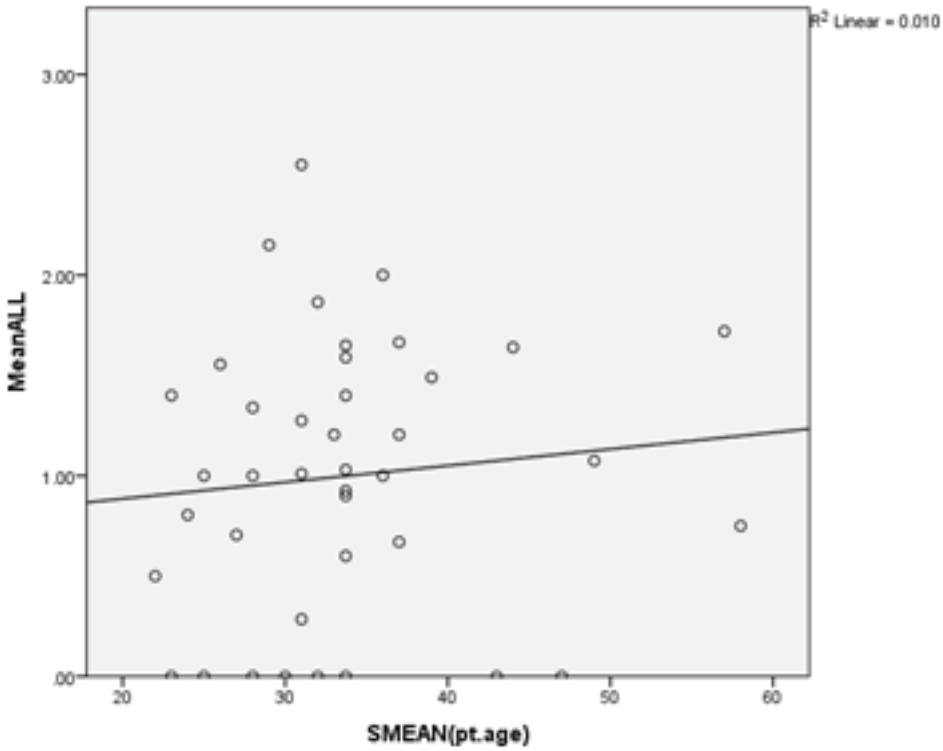
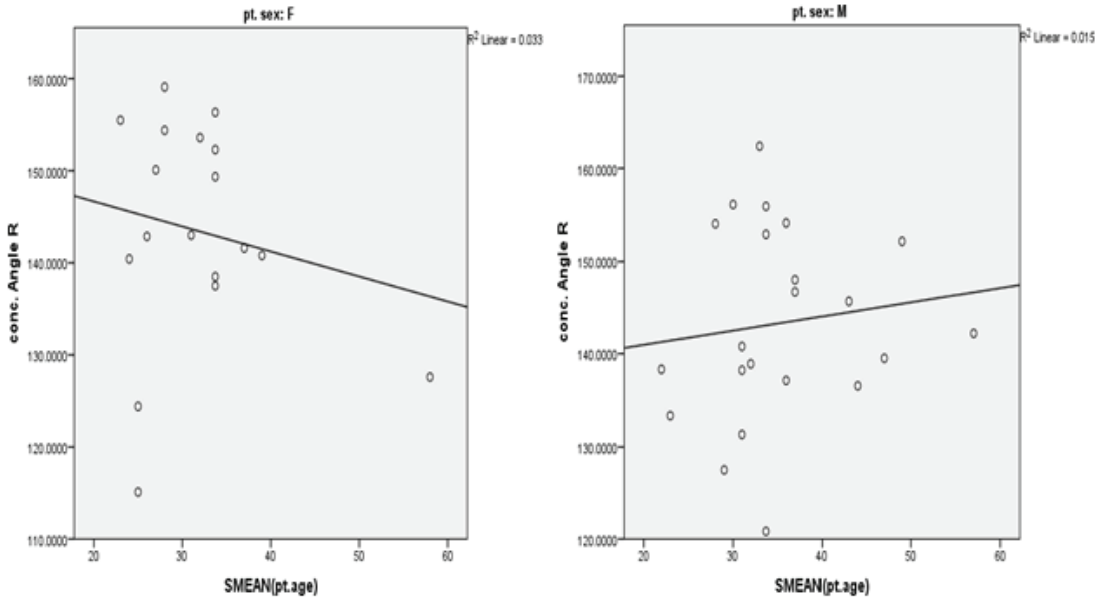


Figure 4 Presence of anterior canal (axial section)

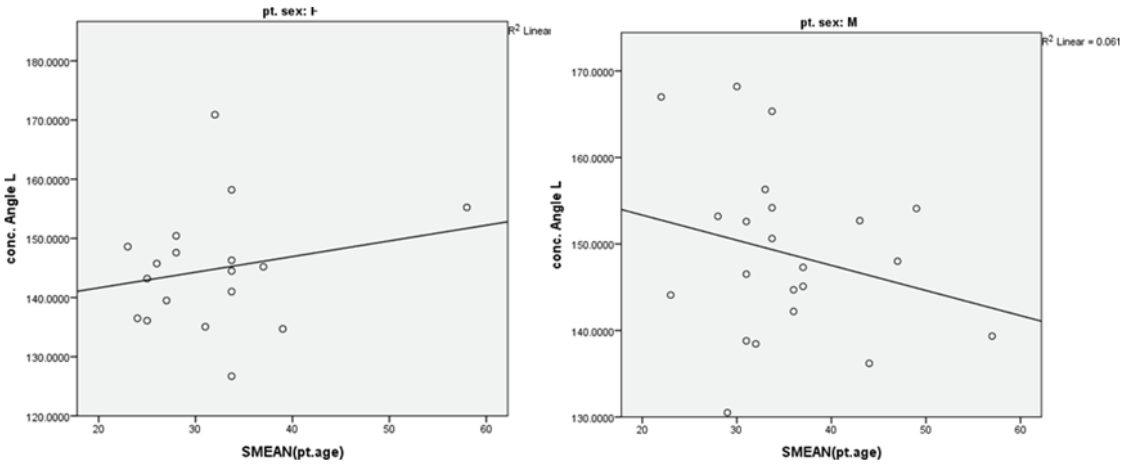
GRAPHS



Graph No. 1: Correlation of age with mean anterior loop length



Graph 2 Lingual concavity angle and correlation with gender



Graph3 Lingual concavity angle and correlation with left side age

Discussion

In the current study evaluation of the mental loop and lingual concavity was done on CBCT images, and the study has found that the mean length of anterior loop was 0.9989 mm with a standard deviation of 0. 67932. These results suggest a possibility of trauma to the nerve in case of performing an osteotomy for implant placement or any surgical approach in the premolar area. In one of the previous studies their results showed a mean length of anterior loop length was ranging between 0.21 and 2.71 mm.[4] The difference in the results between our study and theirs can be due to different sample size, different age of examined patients, race, or dental status. In some studies, correlation between anterior loop length and the gender of the patient was significant.[9] While in this study, there is no significant correlation between anterior loop length and Gender. Some studies were observing the correlation between right and lefts side of the anterior loop length[2] while in our study our focus was on the correlation of the Anterior loop length with gender and age. In another study anterior loop length has shown a significant correlation among

different age groups, but in the current study there is no correlation found with age of the patients.[4] Chan et al in their study has classified lingual concavity into C (convex) P (parallel), and U (undercut) while in our study lingual concavity was classified into A (acute undercut) B (stream line), and C (kidney shape) which is more clinically useful in implant planning.[3] In one of the studies reviewed previously they did lingual concavity analysis in the canine area also not only in the posterior region. However, they also concluded that most of the cases observed the presence of lingual concavity is in the second molar region which is the same result derived and in agreement with the study. In one of the studies, a positive relationship between mandibular lingual concavity with age and gender was observed which was endorsed in our study.[6] The following conclusions were drawn from the study are given below with the use of CBCT as a preoperative investigation aids in minimizing the complications and it helps in knowing the degree of angulation of hand piece needed while performing the osteotomy.

In conclusion the ridge inclination, (with reference to buccal cortical plate) was ranging from 11-20 degrees in majority of patients. It also sheds light on the accurate safe distance needed to avoid any damage to adjacent mental nerve and inferior alveolar nerve. Angle of the depth of lingual concavity was commonly ranging from 141°- 160° (Grade III) in 60% of the right side samples and 65% of the left side samples examined. Avoidance of post-surgical complications such as perforation of the lingual concavity or violation to the mental nerve can be achieved by the use of accurate investigation methods like CBCT. Improper placement of implants without cone beam CT image analysis in the molar region of the mandible may result in perforation of the lingual cortex due to severely inclined ridge or deep lingual concavity especially in the 2nd mandibular molar region. Mental loop varies in length so much between the patients as observed in this study so CBCT investigation is recommended to know the exact safe distance in implant placement as there was one male patient showing length exceeding 3mm, more than the expected anterior loop length. There is also presence of anterior canal as an extension of mental loop in 12.5% of patients examined. In this study, we devised new clinically useful morphological classification of the lingual concavity. I would recommend the future studies to have larger sample size and observation within family members, racial groups in order to evaluate the relation of anterior loop and lingual concavity with hereditary or genetic factors.

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Conflict of Interest - Nil

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