Original Research Article

Verification the validity of CBCT reference values as a guide for a profound inferior alveolar nerve block

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Abstract

Background: Cone-beam computed tomography (CBCT) has picked up ubiquity in the field of indicative oral and maxillofacial imaging. CBCT imaging has particularly the capability of giving unambiguous data to the limitation of mandibular complex life structures.
Aim: To verify the validity of previous reference values for enhancing successful inferior alveolar nerve block using cone beam computed tomographic images.
Materials and methods: The current study comprised of 40 living non-pathological (that might alter the relationship of the mandibular foramen exit site containing the IAN) patients records of 80 mandibular foramen bilaterally 14 males and 26 females aged 20-70 years were selected out of 200 archived records fulfilling the eligibility criteria including: the presence of the mandibular second molar and the mandibular premolars. All the patients were randomly selected and scanned with CBCT for various purposes using a Promax®3D Mid CBCT device (PlanmecaOy, Helsinki, Finland).
Results: There was a statistic significant difference regarding maximum height and angle while no difference regarding the minimum height.
Conclusion: The mandibular complex anatomy is located approximately from the contralateral premolar $33^{o} – 34^{o}$ and 6.5 mm above the mandibular occlusal plane which are the best parameters for obtaining more reliable and repeatable technique for nerve block during orientation of syringe barrel.

Key words

Mandibular foramen, Inferior alveolar nerve, CBCT.

Introduction

Tragically, inferior alveolar nerve (IAN) block can be a standout amongst the most disappointing methodology when the result is deficient or ineffectual anesthesia as an expected 15%-20% of IAN infusions come up short when regulated by substantial distinguishing intraoral points of interest. This proposes variety in the area of the IAN exists inside the patient populace. To limit analgesic disappointment, the dental practitioner must have sound information of the life systems of the head area, especially the neuroanatomy of the maxillary and mandibular areas of the face that ought to help the dental practitioner to enhance his or her capacity to induce significant nearby anesthesia [1-8].

Cone-beam computed tomography (CBCT) has picked up ubiquity in the field of indicative oral and maxillofacial imaging, creates high determination, superimposition free, non-amplified and undistorted three-dimensional (3D) pictures of the maxillofacial life structures that can be reformatted in any coveted plane for intuitive survey and picture control, thus, encouraging 3D perception, assessment and investigation. CBCT imaging has particularly been upheld for the evaluation of calcified structures and deciding the limits of high thickness tissues, for example, the alveolar bone covering of teeth, the land area of affected teeth, or bone volume before implantation and estimations in light of multiplanar reformatted pictures were generally precise. This exactness has the capability of giving unambiguous data to the limitation of mandibular complex life structures [9-12].

Two customizable variables that may be utilized to find the mandibular foramen (MF) incorporate syringe and needle angulation and the distance over the mandibular occlusal plane. Late reviews assessing the precision of cone beam computed tomography (CBCT) imaging programming advanced estimations in the vicinity of 0.07 and 0.27 mm when contrasted and known institutionalized estimations compared. These reviews likewise announced high affectability as to precisely distinguishing the structure measured [8, 13].

Materials and methods

The current study comprised of 40 living non-pathological (that might alter the relationship of the mandibular foramen exit site containing the IAN) patients CBCT records of 80 mandibular foramen bilaterally 14 males and 26 females aged 20-70 years were selected out of 200 archived records fulfilling the eligibility criteria including: the presence of the mandibular second molar for the distance over the mandibular occlusal plane and the mandibular premolars for the angulation measurement. All the patients were randomly selected and scanned with CBCT for various purposes using a Promax® 3DMid CBCT device (PlanmecaOy, Helsinki, Finland).

The CBCT measurements were taken using "***PlanmecaRomexis viewer 3.5.1.R"*** software with the distance and angulation measurement tool. The measurements were taken on axial and corrected sagittal slices (**Figures - 1, 2**). All the CBCT measurements were taken twice at two different sessions and the average of the two measurements was considered the final one to avoid the intra observer errors.

Figure – 1: The height measurement from the mandibular occulsal plane of second molar to the center of mandibular foramen in CBCT corrected sagittal view.

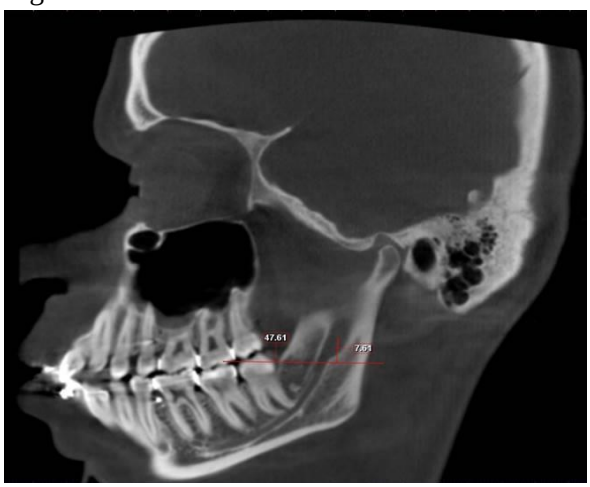
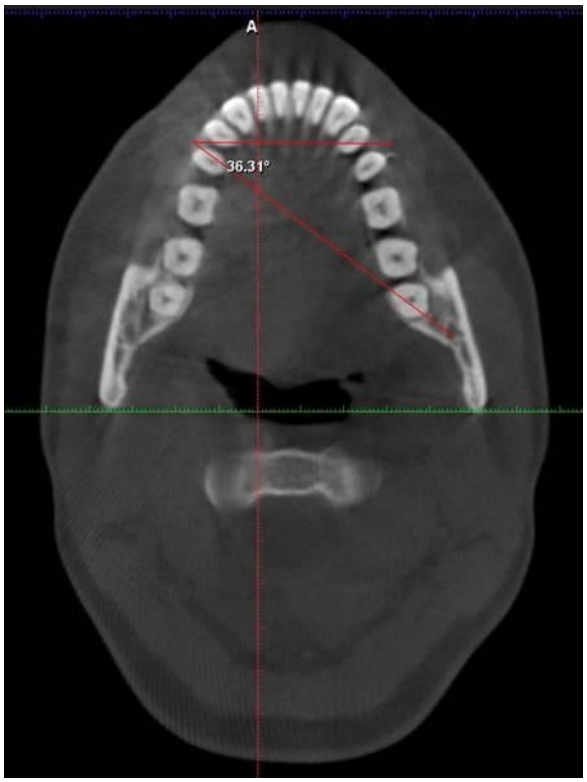


Figure – 2: The angulation measurement from the contralateral contacts of premolars to the mandibular foramen in CBCT axial view.



One independent well trained radiologist with experience more than 10 years conducted all the CBCT anatomic measurements after appropriate training and working on the software used in this study (***Planmeca Romexis viewer 3.5.1.R***).

Measurements accomplished regarding the angle from the contralateral premolar contact area to the mandibular foramen using the horizontal axis as the mandible and vertical axis as the midline of the face by scrolling directly through the axial cuts and the distance above the mandibular occlusal plane as measured from the distal lingual cusp tip of the second mandibular molar to the center of the mandibular foramen from the corrected sagittal cuts. Scans were randomly selected from either the right or left side of each patient (**Figure - 1, 2**).

Axial and corrected sagittal images were used for the radiographic evaluation of the distance and angle measurement, the axial cut acts as a scout image to export the corrected sagittal image by rotation of both vertical and horizontal axes for each side separately.

Statistical analysis

The inter-rater reliability was assessed using a two-way mixed, absolute agreement, single measures ICC to assess the degree of reliability between observers for height and Angle. The values compared to the correspondent reference values (Blacher, et al., 2016) [8] using one sample t-test. Independent t-test used to compare between male and female tested samples. Statistical analysis was performed with IBM® SPSS® (SPSS Inc., IBM Corporation, NY, USA) Statistics Version 24 for Windows.

Results

ICC results

The inter-rater reliability was assessed using a two-way mixed, absolute agreement, single measures ICC (interclass correlation) to assess the degree of reliability between observers for height and Angle. The ICC value was high (ICC = 0.844, 95 CI (confidence interval) % 0.756, 0.9, P < 0.001) indicating a high degree of reliability and suggesting that height was measured similarly by the 2 observes. A lower value for ICC (ICC = 0.781, 95 CI% 0.658, 0.859, P < 0.001) but also indicating a high degree of reliability and suggesting that Angle was measured similarly by the 2 observes. Comparison between the values and reference values was as per **Table – 1**.

The mean angle values for the right and left sides were 33.84±2.37, 34.56±2.92 respectively. However, the result of one sample t-test in comparison to the reference values revealed that there was a statistically significant difference between the angle values for the right and left sides and the reference values.

The mean maximum height values for the right and left sides were 6.66±2.36, 6.25±2.21 respectively. However, the result of one sample t-test in comparison to the reference values revealed that there was a statistically significant

difference between the maximum height values for the right and left sides and the reference values.

While the mean minimum height values for the right and left sides were 6.66±2.36, 6.25±2.21 respectively. However, the result of one sample t-test in comparison to the reference values revealed that there was no statistically significant difference between the minimum height values for the right and left sides and the reference values.

The mean angle values of the male for the right and left sides were 32.85±1.86, 33.85±3 respectively. The mean angle values of the female for the right and left sides were 34.44±2.48, 34.99±2.85 respectively. However, the result of independent t-test between Male and female revealed that there was a statistically significant difference between the angle values for the right side between Male and female and not for the left side. Comparison between the male and female was as per **Table – 2**.

Table - 1: Mean and standard deviation (SD) for Angle and height for RT and LT side as well as the results of one sample t-test in comparison to the reference values.

	Mean	**SD**	**t**	**p-value**	**Mean Difference**	**Reference Value**
Angle (RT)	33.84	2.37	-29.73	≤0.001*	-11.16	45
Angle (LT)	34.56	2.92	-22.58	≤0.001*	-10.44	45
Height (RT)	6.66	2.36	-8.94	≤0.001*	-3.34	10
Height (RT)	6.66	2.36	1.75	0.087 NS	0.66	6
Height (LT)	6.25	2.21	-10.71	≤0.001*	-3.75	10
Height (LT)	6.25	2.21	0.72	0.477 NS	0.25	6

**=significance, NS= Non-significant*

Table - 2: Mean and standard deviation (SD) for Angle and height and results of independent t-test between Male and female.

	Gender				**p-value**
	Male		**female**		
	Mean	**SD**	**Mean**	**SD**	
Angle (RT)	32.85	1.86	34.44	2.48	0.039*
Angle (LT)	33.85	3.00	34.99	2.85	0.240 NS
Height (RT)	7.15	2.05	6.36	2.53	0.311 NS
Height (LT)	6.94	2.17	5.84	2.18	0.131 NS

**=significance, NS= Non-significant*

The mean height values of the male for the right and left sides were 7.15±2.05, 6.94±2.17 respectively. The mean height values of the female for the right and left sides were 6.36±2.53, 5.84±2.18 respectively. However, the result of independent t-test between Male and female revealed that there was no statistically significant difference between the height values for the right and left sides between Male and female.

Discussion

The success of inferior alveolar nerve block technique is dependent on placing the needle tip in close proximity to the MF, Therefore variability in its location may lead to failure of anesthesia. The internal structure cannot be palpated clinically, so, standard teaching is to use landmarks to estimate its location is mandatory.

A few reviews have demonstrated precise needle position alone does not ensure fruitful pulpal anesthesia. Change in the anatomic historic points utilized as a part of recognizing the

MF/IAN complex makes clinical conveyance of IAN anesthesia testing. A significant number of these disappointments are related with vascular harm and varieties in the anatomic example and position of the MF/IAN complex and encompassing delicate tissues situated inside the pterygomandibular space and in addition with irreversible pulpitis, either symptomatic or asymptomatic. The clinician must have the capacity to evaluate whether administrator mistake or anatomical irregularity is to be faulted for insufficient agony administration, for example, bifid trenches, retromadibular foramen and frill mylohyoid nerve. In this way, understanding and recognizing flexible parameters inside these points of interest can help in controlling sheltered and compelling IAN anesthesia [5, 7, 8, 14-19].

In this study, MF/IAN was radiographically localized with respect to angulation and height above the mandibular occlusal plane. The mean angle values for the right and left sides were 33.84, 34.56 respectively. However, the result of one sample t-test in comparison to the reference values uncovered that there was a statistically significant difference between the angle values for the right and left sides and the reference value which is 45.

The mean maximum height values for the right and left sides were 6.66, 6.25 respectively. However, the result of one sample t-test in comparison to the reference values revealed that there was a statistically significant difference between the maximum height values for the right and left sides and the reference value which is 10.

While the mean minimum height values for the right and left sides were 6.66, 6.25 respectively. However, the result of one sample t-test in comparison to the reference values revealed that there was no statistically significant difference between the minimum height values for the right and left sides and the reference value which is 6.

The present results revealed that the MF/IAN complex is located approximately from the contralateral premolar $33^{o} - 34^{o}$ and 6.5 mm above the mandibular occlusal plane which are the best parameters for obtaining more reliable and repeatable technique for nerve block during orientation of syringe barrel.

The mean angle values of the male for the right and left sides were 32.85, 33.85 respectively, the mean angle values of the female for the right and left sides were 34.44, 34.99 respectively. However, the result of independent t-test between Male and female revealed that there was a statistically significant difference between the angle values for the right side between Male and female and not for the left side. Although there is a statistically significant difference between the angle values for the right side between Male and female but it is very minor and of no clinical significance.

The mean height values of the male for the right and left sides were 7.15, 6.94 respectively, the mean height values of the female for the right and left sides were 6.36, 5.84 respectively. However, the result of independent t-test between Male and female revealed that there was no statistically significant difference between the height values for the right and left sides between male and female.

The present results were against Blacher, et al., 2016 [8] regarding minimum height for the right and left sides 9.85, 9.81 respectively. While at the same time our results were in consistency with him regarding the angulation and the maximum height.

Eventually the current results revealed great difference in the angulation and maximum height values in respect to the reference values which have been stated by previous studies. Emphasizing the fact mentioned before regarding the great variations in MF/IAN anatomy are highly individualistic regardless age or gender as stated by Afsar, et al., 1998 [20], Malamed SF, 2004 [21], Iwanaga, et al. [22], Khoury, et al.,

2010, 2011 [17, 18], as well. So, further studies on expanded scales are needed to set the most reliable angulation and height reference values.

Conclusions

The mandibular complex anatomy is located approximately from the contralateral premolar 33^{o} – 34^{o} and 6.5 mm above the mandibular occlusal plane which are the best parameters for obtaining more reliable and repeatable technique for nerve block during orientation of syringe barrel.

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