Study of the Course of the Inferior Dental Canal in the Iraqis Population Using Cone Beam Computed Tomography

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Abstract

Introduction: The inferior alveolar nerve (IAN) is one of the most important vital structures found in the mandible, knowing the precise location of the mandibula canal is helpful to decrease the incidence and avoid the injury to the (MC).

Material & Method:30 males & 30 females were selected from the data of the (CBCT) stored in the computer joined to the device and the measurements were taken as follow " The first section in trans-axial view after mental foramen, where the loop of mandibular canal is formed, was selected as point A and interludes of 10 mm were selected for subsequent measurements (respectively, points B,C,D). On these sections, the shortest linear distances (in mm) from the most lingual aspect of the canal to the outer lingual cortical plate of the mandible(L) and from the mandibular canal to the inferior border of mandibular body(I) were measured. Furthermore, the minimum distance between the buccal cortices and the mandibular canal(B) were evaluated" as in (Fig. 1). Using SPSS software Version 15 the data that had been obtained was analyzed.

Results: The results had been showed that there is no significant difference in measurements were taken between males and females groups in the measurement of the distance of the inferior dental canal to the buccal cortical and in the measurement of the distance of the inferior dental canal to lingual cortical bone of the mandible , only in the measurement of the (IDC) to inferior border of the mandible there was a significant difference in only one point

Conclusion: It can be concluded from this study that the information can be obtained by the (CBCT) about the location of the (MC) can helpful for the surgeons to avoid damage to (MC) throughout surgical procedures in the mandible , and those information can give good overview and conception for course of the (MC) through the mandible.

Key words : *inferior alveolar canal, cone beam computed tomography*

Introduction

The inferior alveolar nerve (IAN) is one of the most important vital structures found in the lower jaw ,it is the largest branch of the mandibular nerve which is the 3rd division of the trigeminal nerve, the (IAN) has a great attention in the surgical treatment of the area of the mandible(1), the inferior dental canal (IDC) changes the buccolingual direction and the vertical direction in its course inside the mandible, it is very important to locate the precise location of the mandibular canal(MC) to make the treatment plan for the surgery would be involving the mandible and avoid the injury of the (MC) throughout the surgery(2). The difference in the anatomical location of the (MC) must be constantly taken into consideration to avoid (MC) injury throughout surgical procedure involving the mandible such as dental implant, extraction of impacted 3d molar, osteotomy, repair of fractured mandible, placemen of screw, and orthognathic surgery(3). During dental implant procedures and orthognathic surgeries it was noticed that the average of neurosensory disturbance of (IDC) was up to 77.8 and 65.1% respectively(4), throughout the surgical extraction of the impacted mandibular third

molar the rate of (IDC) injury was recorded to be 0.4-13.4%[5], studies showed that during the bilateral sagittal split osteotomy of the mandible as the (MC) closer to the buccal aspect of the mandible the rate of (MC) injury would be increased[6-10].

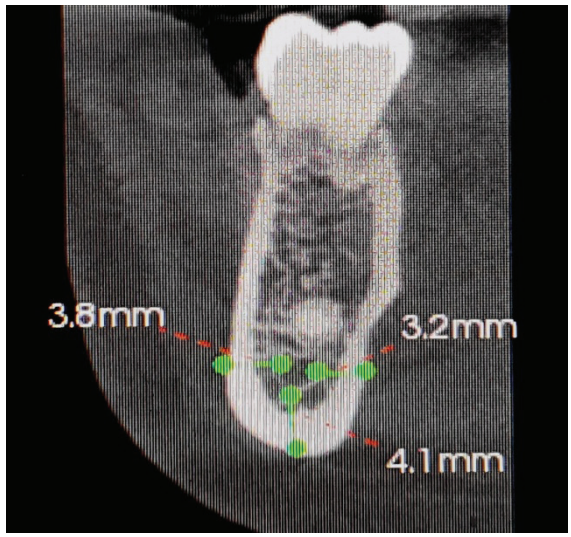
using cone beam computed tomography in the evaluation of the course and anatomic location of the mandibular canal was carried out in previous studies[11-13]

The aims of this study were to evaluate if the difference in the gender would be effective in the prediction of the relative location of the canal and to assess the relation of the location of the (MC) to the cortices of the mandible utilizing CBCT.

Material and Method

The study was approved by the Ethical Committee of Collage of Dentistry, University of Tikrit, the study was done in the department of radiology in the specialized dental center, ministry of the health in Tikrit city, from the pool of data of the

cone beam computed tomography (care stream) made in Germany, 30 males and 30 females were selected without any pathological condition or fracture can affect the normal position of the Inferior Dental Canal, after making reconstructed panorama to reveal the course (IDC) from the mental foramen to the mandibular foramen in slice thickness 0.5 mm , according to the study was done by Hooman Khorshidi et al in 2017[13] the measurement were taken as follow " The first section in trans-axial view after mental foramen, where the loop of mandibular canal is formed, was selected as point A and interludes of 10 mm were selected for subsequent measurements (respectively, points B,C,D). On these sections, the shortest linear distances (in mm) from the most lingual aspect of the canal to the outer lingual cortical plate of the mandible(L) and from the mandibular canal to the inferior border of mandibular body(I) were measured. Furthermore, the minimum distance between the buccal cortices and the mandibular canal(B) were evaluated" as in (Fig. 1). Using SPSS software Version 15 the data that had been obtained was analyzed.



Figure(1):" Measurement of the shortest linear distances (mm) from the most buccal and lingual aspects of the canal to the corresponding cortical plates of the mandible and also the minimum linear distance between the inferior aspect of canal and inferior border of mandible in an CBCT image"

Results

The results had been showed that there is no significant difference in measurements were taken between males and females groups in the measurement of the distance of the inferior dental canal to the buccal cortical and in the measurement of the distance of the inferior dental canal to lingual cortical bone of the mandible , only in the measurement of the (IDC) to inferior border of the mandible there was a significant difference in only one point as the table (1) and the abbreviation were used in the table as follow:

A: the 1st point

BA: the distance of the (IND) to the buccal cortical pate in the point A

LA: the distance of the (IND) to the lingual cortical pate in the point A

IA: the distance of the (IND) to inferior border of the mandible in the point A

B: the 2nd point

BB: the distance of the (IND) to the buccal cortical pate in the point B

LB: the distance of the (IND) to the lingual cortical pate in the point B

IB: the distance of the (IND) to inferior border of

the mandible in the point B

C: the 3rd point

BC: the distance of the (IND) to the buccal cortical pate in the point C

LC: the distance of the (IND) to the lingual cortical pate in the point C

IC: the distance of the (IND) to inferior border of the mandible in the point C

D: the 4th point

BD: the distance of the (IND) to the buccal cortical pate in the point D

LD: the distance of the (IND) to the lingual cortical pate in the point D

ID: the distance of the (IND) to inferior border of the mandible in the point D

Table -1- the measurements of the distances of the inferior dental canal to buccal and lingual cortical plates and to the inferior border.

Measured distance	Male				Female				P-Value
	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	
A									
BA	3.8700	0.91324	2.50	5.70	3.8700	0.91324	2.50	5.70	1.000
LA	4.9100	1.10694	3.70	7.20	4.9100	1.10694	3.70	7.20	1.000
IA	11.0300	1.61920	7.30	13.10	2.8100	11.0300	7.30	13.10	1.000
B									
BB	5.8700	1.42547	2.50	7.30	5.9900	1.15813	3.70	7.30	0.614
LB	3.4000	0.81677	2.00	4.30	3.4000	0.81677	2.00	4.30	1.000
IB	7.4600	1.50538	5.10	9.50	74600	1.50538	5.10	9.50	1.000
C									
BC	6.7900	0.82476	5.70	8.10	6.7900	0.82476	5.70	8.10	1.000
LC	2.8400	1.31190	1.40	5.60	2.8400	1.31190	1.40	5.60	1.000
IC	7.2600	1.43056	5.10	9.30	6.5100	2.02063	1.80	8.70	0.21
D									
BD	6.3500	1.27817	4.30	8.70	6.3500	1.27817	4.30	8.70	1.00
LD	2.8100	1.18589	1.30	4.60	2.8100	1.18589	1.30	4.60	1.00
ID	6.700	2.19414	2.10	9.50	6.700	2.19414	2.10	9.50	1.00

Discussion

Several studies have been concluded that the knowledge of the relative position of the (IDC) to the buccal and lingual cortical bone of the mandible and to the inferior border of the mandible is important to predict and avoid the loss of sensory in the mandibular nerve[7-9], the textbooks of anatomy do not describe in detail the course of the mandibular canal, there are several studies to give comprehensive understanding of the course of the mandibular canal such as clinical observation throughout surgical procedures[14],measurement on dry skull[2,15-17], traditional radiograph[6,18-20], and computed tomography scan[7,8,21-24], each one of the methods mentioned above has limitation such as change in dimension in dry skull, 2D and change in the size in the traditional radiograph,and high dose of radiation in CT scan, Kamburog˘lu et al. and Eizenbud et al. showed that the method of the using of CBCT to predict the course of the mandbular canal is the most non invasive and precise method used till now [25,26], the results of this study have been showed there is no significant difference in the buucolingual relative position of the mandibular canal between males & females groups and those come in accordance with the studies of Simonton JD, et, al[27] , Kane AA,et,al, Angel et al[28], The studies of de Oliveira Ju´nior et[29] al. and Hooman Khorshidi et al[13] showed that the all measurements were smaller in female group than males group in our study that com in agreement only in measurement of mandibular canal to inferior border of the mandible and only in one point of the measurements and in the other 3 points there were no significant difference and may be difference in the races was the reason, the whole results were fairly constant in both males and females groups, our results have been suggested that as the mandibular canal runs from the entrance of the mandible in the mandibular foramen to the mental foramen the (MC) would be toward the buccal side as the (MC) runs anteriorly and the values of the means of the lingual measurements decreased as (MC) runs anteriorly and that is come in agreement with the studies of Ylikontiola L[6], and Hooman Khorshidi et al[13], de Oliveira Ju´nior MR. et,al[29],

It can be concluded from this study that the information can be obtained by the (CBCT) about the location of the (MC) can helpful for the surgeons to avoid damage to (MC) throughout surgical procedures in the mandible , and those information can give good overview and conception for course of the (MC) through the mandible.

Ethical Clearance: The Research Ethical Committee at scientific research by ethical approval of both environmental and health and higher education and scientific research ministries in Iraq

Conflict of Interest: The authors declare that they have no conflict of interest.

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References

1. Nortje C, Farman A, Grotepass F . Variations in the normal anatomy of the inferior dental (mandibular) canal: a retrospective study of panoramic radiographs from 3612 routine dental patients. Br J Oral Surg. 1977; 15:55–63.
2. Ozturk A, Potluri A, Vieira AR . Position and course of the mandibular canal in skulls. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012; 113:453–458.
3. Nagadia R, Tay A, Chan L, Chan E-Y . The spatial location of the mandibular canal in Chinese: a CT study. Int J Oral Maxillofac Surg. 2011; 40:1401–1405.
4. Gerlach NL, Meijer GJ, Maal TJ, Mulder J, Rangel FA, Borstlap WA et al . Reproducibility of 3 different tracing methods based on cone beam computed tomography in determining the anatomical position of the mandibular canal. J Oral Maxillofac Surg.2010; 68:811–817
5. Cheung LK, Leung Y, Chow L, Wong M, Chan E, Fok Y . Incidence of neurosensory deficits and recovery after lower third molar surgery: a prospective clinical study of 4338 cases. Int J Oral Maxillofac Surg. 2010; 39:320–326.
6. Ylikontiola L, Moberg K, Huumonen S, Soikkonen K, Oikarinen K . Comparison of three radiographic methods used to locate the mandibular canal in the buccolingual direction before bilateral sagittal split osteotomy. Oral Surg Oral Med Oral Pathol Oral Radiol Endodontol. 2002; 93:736–742.
7. Yoshioka I, Tanaka T, Khanal A, Habu M, Kito S, Kodama M et al . Relationship between inferior alveolar nerve canal position at mandibular second molar in patients with prognathism and possible occurrence of neurosensory disturbance after sagittal split ramus osteotomy. J Oral Maxillofac Surg. 2010; 68:3022–3027.

8. Yoshioka I, Tanaka T, Habu M, Oda M, Kodama M, Kito S et al. Effect of bone quality and position of the inferior alveolar nerve canal in continuous, long-term, neurosensory disturbance after sagittal split ramus osteotomy. J Cranio-Maxillofac Surg. 2012;40:e178–e183.
9. Huang CS, Syu JJ-S, Ko EW-C, Chen YR . Quantitative evaluation of cortical bone thickness in mandibular prognathic patients with neurosensory disturbance after bilateral sagittal split osteotomy. J Oral Maxillofac Surg. 2013; 71:2153-e1
10. Yamamoto R, Nakamura A, Ohno K, Michi KI . Relationship of the mandibular canal to the lateral cortex of the mandibular ramus as a factor in the development of neurosensory disturbance after bilateral sagittal split osteotomy. J Oral Maxillofac Surg. 2002; 60:490–495.
11. Angel JS, Mincer HH, Chaudhry J, Scarbecz M . Conebeam computed tomography for analyzing variations in inferior alveolar canal location in adults in relation to age and sex*. J Forensic Sci. 2011; 56:216–219
12. Balaji S, Krishnaswamy N, Kumar SM, Rooban T . Inferior alveolar nerve canal position among South Indians: a cone beam computed tomographic pilot study. Ann Maxillofac Surg. 2012; 2:51.
13. Hooman Khorshidi, Saeed Raoofi, Janan Ghapanchi, Shoaleh Shahidi,Maryam Paknahad. Cone Beam Computed Tomographic Analysis of the Course and Position of Mandibular Canal, J. Maxillofac. Oral Surg. 2017; 16(3):306–311
14. Tammisalo T, Happonen R-P, Tammisalo EH . Stereographic assessment of mandibular canal in relation to the roots of impacted lower third molar using multiprojection narrow beam radiography. Int J Oral Maxillofac Surg. 1992; 21:85–89.
15. Kim HJ, Lee HY, Chung IH, Cha IH, Yi CK . Mandibular anatomy related to sagittal split ramus osteotomy in Koreans. Yonsei Med J.1997; 38:19–25.
16. Gowgiel J . The position and course of the mandibular canal. J Oral Implantol .1991;18:383–385
17. Kieser J, Paulin M, Law B . Intrabony course of the inferior alveolar nerve in the edentulous mandible. Clin Anat. 2004; 17:107–111.
18. Klinge B, Petersson A, Maly P. Location of the mandibular canal: comparison of macroscopic findings, conventional radiography, and computed tomography. Int J Oral Maxillofac Implants.1988; 4:327–332.
19. Kondo T, Ong S, Foong KW . Computer-based extraction of the inferior alveolar nerve canal in 3-D space. Comput Methods Programs Biomed.2004; 76:181–191.
20. Liu T, Xia B, Gu Z . Inferior alveolar canal course: a radiographic study. Clin Oral Implant Res. 2009; 20:1212–1218.
21. Ma J, Lu L, Song C. The position and course of mandibular canal through mandibular ramus in patients with prognathism. Shanghai kou qiang yi xue = Shanghai J Stomatol. 2008;17:200–203.
22. Yu I, Wong Y . Evaluation of mandibular anatomy related to sagittal split ramus osteotomy using 3-dimensional computed tomography scan images. Int J Oral Maxillofac Surg. 2008; 37:521–528.
23. Tsuji Y, Muto T, Kawakami J, Takeda S . Computed tomographic analysis of the position and course of the mandibular canal: relevance to the sagittal split ramus osteotomy. Int J Oral Maxillofac Surg. 2005; 34:243–246
24. Wittwer G, Adeyemo W, Beinemann J, Juergens P . Evaluation of risk of injury to the inferior alveolar nerve with classical sagittal split osteotomy technique and proposed alternative surgical techniques using computer-assisted surgery. Int J Oral Maxillofac Surg. 2012; 41:79–86.
25. Kamburog˘lu K, Kılıc¸ C, O¨ zen T, Yu¨ksel SP . Measurements of mandibular canal region obtained by cone-beam computed tomography: a cadaveric study. Oral Surg Oral Med Oral Pathol Oral Radiol Endodontol.2009; 107:e34–e42
26. Aizenbud D, Ciceu C, Hazan-Molina H, Abu-El-Naaj I . Relationship between inferior alveolar nerve imaging and neurosensory impairment following bilateral sagittal split osteotomy in skeletal class III cases with mandibular prognathism. Int J Oral Maxillofac Surg. 2012; 41:461–468.
27. Simonton JD, Azevedo B, Schindler WG, Hargreaves KM Age-and gender-related differences in the position of the inferior alveolar nerve by using cone beam computed tomography. J Endod. 2009;35:944–949.
28. Kane AA, Lo L-J, Chen Y-R, Hsu K-H, Noordhoff MS . The course of the inferior alveolar nerve in the normal human mandibular ramus and in patients

presenting for cosmetic reduction of the mandibular angles. Plast Reconstr Surg.2000;106:1162–1174.

29. de Oliveira Ju´nior MR, Saud ALS, Fonseca DR, De-Ary-Pires B, Pires-Neto MA, de Ary-Pires R . Morphometrical analysis of the human mandibular canal: a CT investigation. Surg Radiol Anat,2011; 33:345–352.