A CONE-BEAM COMPUTED TOMOGRAPHY BASED ASSESSMENT OF MENTAL FORAMEN POSITION

Qasim Nafees Ahmad, Muhammad Nazir Khan, Atta-Ur-Rehman, Alina Shahid*, Wajahat Ghafoor, Saqib Ghafoor Kiani

Armed Forces Institute of Dentistry/National University of Medical Sciences (NUMS) Rawalpindi Pakistan, *Armed Forces Institute of Cardiology/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: To analyze the position of the mental foramen in relation to gender and side using Cone-beam Computed Tomography (CBCT) images for providing the grounds for a better understanding of the anatomy of the region leading to better treatment planning and outcome.
Study Design: Cross-sectional descriptive study.
Place and Duration of Study: Department of Oral & Maxillofacial Surgery, Armed Forces Institute of Dentistry, Rawalpindi from Dec 2014 to May 2015.
Material and Methods: The study included CBCT images of 64 patients (32 male & 32 females) above the age of 18 years obtained from the main departmental data. Position of the MF was analyzed using the 3D reconstruction of the images in relation to the long axis of associated teeth in mandibular arch. In addition, pattern of emergence of the foramen (using axial section) and presence of accessory mental foramen was also noted.
Results: In our study group the most common position of the MF associated with second premolar (54.7%) on right side and 67.2% on left side. Straight pattern of E was found most commonly both on right (62.5%) and left (47.5%) sides. AMF was found in total 4 cases on right side (6.3%) and in one case on left side (1.6%).
Conclusion: Although the MF is most commonly associated with second premolar however variation in anatomy and presence of AMF should always be kept in mind while performing surgery in the area to avoid the neurosensory disturbance.

Keywords: Accessory mental foramen, CBCT, Emergence pattern, Mental foramen, Position.

INTRODUCTION

The Inferior alveolar nerve (IAN) courses through mandibular canal and exits from the body area on each side of mandible through the Mental Foramen (MF) as mental nerve[1]. This terminal branch of IAN provides sensation to area between the mandibular first molars including the teeth, gingiva, buccal vestibule and the lower lip[1,2]. Common surgical procedures undertaken in this area include removal of the teeth/roots, endodontic surgery, removal of pathology like cysts, fixation of the fractures, genioplasty, and bone harvesting[1-4]. The MF can easily be confused as a bony pathology or periapical lesion due to its close proximity to apical area of adjacent tooth[4]. Due to variation in size, and location of MF, prior meticulous surgical planning and knowledge of this important landmark is necessary to achieve optimum anesthesia or to avoid damage to the neurovascular bundle[2-4]. In some patients, another foramen is present which is termed as accessory mental foramen (AMF) or nutritional canals or buccal mandibular foramen[4,5].

Many techniques have been used traditionally to identify exact position of the MF. These include palpation, using anatomical landmarks, direct visualization, periapical radiographs, panoramic radiographs, computed tomography, and cone-beam computed tomography (CBCT)[6]. Each method has its own benefits and short comings. However CBCT has recently gained more popularity. In this technique, 2D images are obtained by the rotation of cone-shaped X-ray source and detector system around the object. A computer algorithm is then used to

Correspondence: Dr Qasim Nafees Ahmad, House # 20, Phase-4, Main Boulevard, Bahria Town, Rawalpindi Pakistan
Email: artisticallyyinsane@gmail.com
Received: 10 Aug 2015; revised received: 19 Mar 2018; accepted: 21 Mar 2018

reconstruct a three-dimensional (3D) data set. This allows a comprehensive evaluation of the anatomy of the region of interest (ROI) which is lacked in conventional radiography[4,7,8]. Aminoshariae *et al* in a recent review termed the CBCT imaging as the best current imaging technology for determination of the MF location[6]. In many of the studies using dried skulls, conventional radiographs and CBCT, the MF has been found to be closely associated with apex of second premolars in most of the cases studied[2,4,6,9]. However in Pakistani population, only one using only panoramic radiographs has been done[10].

Current study was planned to analyze the position of MF in relation to gender and side. This is a first ever study conducted in Pakistan using CBCT as imaging technique which would provide a better understanding the anatomy of the area leading to improved treatment planning.

MATERIAL AND METHODS

In this cross-sectional study, 128 sides (64 patients divided in two equal groups of males and females) were selected from the CBCT database in the department of Oral & Maxillo-facial surgery, Armed Forces Institute of Dentistry, Rawalpindi from 1st December 2014 to 30th May 2015. Images were taken using the New Tom VGi (QR SRL Co., Verona, Italy) using the following inclusion criteria: Age 18 years or older, bilateral presence of mandibular first and second premolar, and first molar teeth, absence of any pathology, gross malalignment, asymmetry, and fracture in the ROI. Patients selection was done by using convenience sampling technique. The obtained images were evaluated for the position (P) of the MF in relation with first and second premolar, and first molar teeth based on 3 Dreconstruction as following:

P1= in line with mandibular 1st premolar

P2= in line with mandibular 2nd premolar

M1= in line with mandibular 1st molar

P1-P2= between mandibular 1st premolar and 2nd premolar

P2-M1= between mandibular 2nd premolar and 1st molar.

In addition, type of nerve Emergence (E) from the MF (as Posterior, Anterior and Straight) and presence of any AMF was also noted. The data was analyzed descriptively for determining the frequency of P in relation to gender and sideusing SPSS software (SPSS version 20.0, SPSS, Chicago, IL, USA). Quantitative variables were presented by using mean ± SD and qualitative variables were presented by using frequency table and percentages. Association between qualitative variables was assessed by using chi-square test. A p-value<0.05 was taken as significant.

RESULTS

There were overall 128 sides available in total 64 patients 32 (50%) males & 32 (50%) females) with an average age of 34.06 ± 4.75 in males and 30.38 ± 8.14 in females. In general the absence of MF was not noticed in any of the cases and the P2 position was found to be most common (54.7% on right side and 67.2% on left side). As shown in table-I, P2 position on right side was most common in both genders (Male=46.9% and Female=62.5%) followed by P2-M1 position in males (28.1%) and P1-P2and P2-M1 equally in females (both 18.8%). Position M1 was found in only one male on right side. Similarly, on left side, only one case in male group had P1 position. On left side, P2 position was again most common in both genders (Male=65.6% and Female=68.8%). This was followed by P2-M1 and P1-P2 in male group (15.6% and 12.5% respectively while in female group P1-P2 position was second most common position (18.8%) followed by P2-M (12.5%). Only one case in male group has P1 and M1 positions while in female group none has P1 and M1 position on left side.

Table-II summarizes presence of the AMF. Total 4 cases had the AMF on right side (3 males and 1 female). Bilateral AMF was present only in one female.

Table-III summarizes the pattern of E in each gender and side. Overall the straight pattern was seen most commonly (Right=54.7 & Left=45.3) followed by posterior (M=28.1% & F=28.1%) and anterior (M=15.6% & F=18.8%)on right side in both genders and anterior (34.4%) and posterior (21.9%) in females while posterior (37.5%) and anterior (15.6%) in males on left side.

DISCUSSION

Current study which aimed at analysis of position (P) of MF and E pattern of the nerve pattern of emergence was found in most of the cases.

The MF has recently been subject of many studies due to its importance in gaining anesthesia in the region of anterior mandible and also to gain surgical access in endodontic surgery, dental implant placement, genioplasty, orthognathic surgery, fracture management and forensics [1,6,11,12].

In a Pakistani study utilizing panoramic radiography, Punjabi SK *et al* found that mental

Table-I: Summery of the position in relation to gender and side.

	Right Side (n=64)					Left Side (n=64)				
	P1	**P2**	**M1**	**P1-P2**	**P2-M1**	**P1**	**P2**	**M1**	**P1-P2**	**P2-M1**
Male	1 (100%)	15 (42.9%)	1 (100%)	6 (50%)	9 (60%)	1 (100%)	21 (48.8%)	1 (100%)	4 (40%)	5 (55.6%)
Female	0 (0%)	20 (57.1%)	0 (0%)	6 (50%)	6 (40%)	0 (0%)	22 (51.2%)	0 (0%)	6 (60%)	4 (44.4%)
Total	1	35	1	12	15	1	43	1	10	9
p-value*	0.507					0.638				

*: Chi Square, P1: first premolar, P2: second premolar and M1: first molar, *p*-value<0.05: significant

Table-II: Accessory Mental Foramen (AMF in relation to Gender and Side).

	Accessory Mental Foramen (Right) (n=64)		Accessory Mental Foramen (Left) (n=64)	
	Yes	**No**	**Yes**	**No**
Male	3 (75%)	29 (48.3%)	0 (0%)	32 (50.8%)
Female	1 (25%)	31 (51.7%)	1 (100%)	31 (49.2%)
Total	4	60	1	63
p-value*	0.302		0.999	

*: Chi Square, *p*-value<0.05: significant

Table-III: Mental Nerve Emergence type (E) in relation to gender and side.

	Mental Nerve Emergence type E (Right) (n=64)			Mental Nerve Emergence type E (Left) (n=64)		
	Posterior	**Anterior**	**Straight**	**Posterior**	**Anterior**	**Straight**
Male	9 (50%)	5 (45.5%)	18 (51.4%)	12 (63.2%)	5 (31.3%)	15 (51.7%)
Female	9 (50%)	6 (54.5%)	17 (48.6%)	7 (36.8%)	11 (68.8%)	14 (48.3%)
Total	18	11	35	19	16	29
p-value*	0.942			0.165		

*: Chi Square, *p*-value<0.05: significant

along with presence of AMF is first of its kind in Pakistan utilizing CBCT as assessment tool. Other study in Pakistan hasused panoramic radiography[10]. However CBCT is superior to panoramic radiography as it presents a 3D reconstruction of ROI with better clearity[7]. In 64 cases selected from the database, the most commonly observed position of the MF was apical area of second premolar and straight foramen was more closely associated with apical area of second premolar (47.2%) followed by position between first and second premolars (40.4%)[10]. In the present study the most common position was second premolar (overall 61%) followed by position between first and second premolars (overall 17.2) and between second premolar and first molar (18.7%). Our study have slightly different results from this study in that

although the mental foramen was found to be most commonly associated with second premolar but its incidence was 61%. This may be due to difference in using different radiological technology (panoramic radiography) as compared to CBCT in present study which is more accurate and advanced technology and provides a better visualization of the ROI in premolar area.

Unilateral or bilateral absence of the MF has been reported in literature but its incidence is extremely rare[13,14]. In a study on 1,435 dry human skulls (2870 sides) by De Freitas *et al*. Absence of the MF was observed in two cases on right side and one on the left side[14]. None of the the cases in present study showed absence of the MF.

It is evident from different studies that variation in different ethnic groups does exit. In a study by Kumar *et al*, in two different ethnic groups of Indian population, the MF was most commonly found between first and second premolars (59.2%) in Northeast Indians as compared to South Indians where the most common location was long axis of second premolar (62.8%)[15]. In a study by Santini *et al* the most common location of the MF was in line with the long axis of second premolar (48.8%) in Chinese population, between first and second premolar (50.0%) in the European Population and between the second premolar and the first molar (51.5%) in Indian Population[16]. Similar ethnic variations were observed in other studies[17,18].

The frequency of the AMF has been described between 3 and 10.5% in literature[1,4,5,19,20]. In the current study, the AMF was observed to be present in total 5 cases (6.3% on right and 1.6% on left). Bilateral AMF was found in only one case while the rest were found on right side.

The most common E pattern in this study was straight followed by anterior emergence. This is in accordance with the study by Khojastepour *et al* in Iranian population who also used CBCT as assessment tool[4] and in contrast with Kieser *et al*. who utilized cadavers and stated the posterior emergence as the most common type[21].

CONCLUSION

In conclusion, although the MF is most commonly found associated with second premolar yet the clinicians should bear in mind the variation in position and presence of AMF while planning for surgery in the premolar area to prevent neurosensory disturbance or hemorrhage as a result of injury to neurovascular bundle. CBCT can prove to be an effective tool because of it superiority over conventional radiography.

CONFLICT OF INTEREST

This study has no conflict of interest to be declare by any author.

REFERENCES

1. Kalender A, Orhan K, Aksoy U. Evaluation of the mental foramen and accessory mental foramen in Turkish patients using cone-beam computed tomography images reconstructed from a volumetric rendering program. Clin Anat 2012; 25(5): 584-92.
2. Voljevica A, Talovic E, Hasanovic A. Morphological and morphometric analysis of the shape, position, number and size of mental foramen on human mandibles. Acta Med Acad 2015; 44(1): 31-8.
3. Carruth P, He J, Benson BW, Schneiderman ED. Analysis of the Size and Position of the Mental Foramen Using the CS 9000 Cone-beam Computed Tomographic Unit. J Endod 2015; 41(7): 1032-6.
4. Khojastepour L, Mirbeigi S, Mirhadi S, Safaee A. Location of Mental Foramen in a Selected Iranian Population: A CBCT Assessment. Iran Endod J 2015; 10(2): 117-21.
5. Imada TS, Fernandes LM, Centurion BS, de Oliveira-Santos C, Honorio HM, Rubira-Bullen IR. Accessory mental foramina: prevalence, position and diameter assessed by cone-beam computed tomography and digital panoramic radiographs. Clin Oral Implants Res 2014; 25(2): e94-9.
6. Aminoshariae A, Su A, Kulild JC. Determination of the location of the mental foramen: a critical review. J Endod 2014; 40(4): 471-5.
7. De Vos W, Casselman J, Swennen GR. Cone-beam computerized tomography (CBCT) imaging of the oral and maxillofacial region: A systematic review of the literature. Int J Oral Maxillofac Surg 2009; 38(6): 609-25.
8. Horner K, O'Malley L, Taylor K, Glenny AM. Guidelines for clinical use of CBCT: A review. Dentomaxillofac Radiol 2015; 44(1): 20140225.
9. 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; 7(8): 1547-51.
10. Punjabi S, Rehman H, Ahmed S, Haider M. Radiographic position of mental foramen in selected Pakistani population. J Pak Dent Assoc 2010; 19(2): 105-9.

11. Jacobs R, Quirynen M, Bornstein MM. Neurovascular disturbances after implant surgery. Periodontol 2000. 2014; 66(1): 188-202.
12. Sisman Y, Sahman H, Sekerci A, Tokmak TT, Aksu Y. Detection and characterization of the mandibular accessory buccal foramen using CT. Dentomaxillofac Radiol 2012; 41(7): 558-63.
13. Matsumoto K, Araki M, Honda K. Bilateral absence of the mental foramen detected by cone-beam computed tomography. Oral Radiol 2012; 29(2): 198-201.
14. De Freitas V, Madeira MC, Toledo Filho JL, Chagas CF. Absence of the mental foramen in dry human mandibles. Acta Anat (Basel) 1979; 104(3): 353-5.
15. Kumar V, Hunsigi P, Kaipa BR, Reddy R, Ealla KK, Kumar CB, et al. Radiographic localization of mental foramen in Northeast and South Indian ethnic groups of Indian population. J Contemp Dent Pract 2014; 15(6): 766-9.
16. Santini A, Alayan I. A comparative anthropometric study of the position of the mental foramen in three populations. Br Dent J 2012; 212(4): e7.
17. Green RM. The position of the mental foramen: A comparison between the southern (Hong Kong) Chinese and other ethnic and racial groups. Oral Surg Oral Med Oral Pathol 1987; 63(3): 287-90.
18. Santini A, Land M. A comparison of the position of the mental foramen in Chinese and British mandibles. Acta Anat (Basel) 1990; 137(3): 208-12.
19. Naitoh M, Hiraiwa Y, Aimiya H, Gotoh K, Ariji E. Accessory mental foramen assessment using cone-beam computed tomography. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009; 107(2): 289-94.
20. Paraskevas G, Mavrodi A, Natsis K. Accessory mental foramen: an anatomical study on dry mandibles and review of the literature. Oral Maxillofac Surg 2015; 19(2): 177-81.
21. Kieser J, Kuzmanovic D, Payne A, Dennison J, Herbison P. Patterns of emergence of the human mental nerve. Arch Oral Biol 2002; 47(10): 743-7.