Localization of Maxillary Impacted Canine Using Cone Beam Computed Tomography for Assessmentof Angulation, Distance From Occlusal Plane, Alveolar Width and Proximity to Adjacent Teeth

Vian Fouad Rahman, B.D.S., H.D.D. [1]
Ahlam Ahmed Fatah, B.D.S., M.Sc. [2]

ABSTRACT

Backgrounds: Maxillary canine impaction is complicated and time consuming to treat, for being highly diverse in inclination and location; it may be a companied by root resorption of the neighboring teeth. CBCT has been used for its' diagnostic reliability in localization of impacted canine and revealing its' serious local complications.

Objectives: Localization of maxillary impacted canine using cone beam computed tomography for assessment of angulation, distance from occlusal plane, alveolar width and proximity to adjacent teeth.

Subjects and Methods: The study sample was 33 subjects 16 females and 17 males attended to Al-Wasitti general hospital in Baghdad city-Oral and maxillofacial radiology department for CBCT scan investigationfrom November/2015 to April/2016. By using theCS 9000 device, 3D images and coronal, axial and sagittal views obtained to perform the selected measurements.

Results: Contact of impacted canine to the nearby teeth had a strong effect on their root resorption. Vertical or horizontal angulation measurement in axial view, was not possible for a number of cases.Comparison of the angulation measurement validity between axial and coronal views, had showed an obvious statistical difference in coronal view for vertical angulation, and in the axial view for horizontal angulation calculation. Correlation of the canine localizations found in the study with the measurements, showed a significant statistical difference with age and vertical angulation (coronal view). Age or gender correlation with the measurements wasnon significant statistically, except for age with vertical angulation (coronal view).

Conclusion: utilization of CBCT provides a worthy data about the impacted maxillary canine localization, for more explanation and treatment of these cases surgically and by orthodontics.

Keywords: localization, canine, maxillary, CBCT, impaction..**(J BaghColl Dentistry 2017; 29(1):70-75).**

INTRODUCTION

The secondary cuspidrepresent the establishment of dynamic occlusion in addition to equiponderant smile.[1]The canine is the pillar or corner stone of the maxillary arch.[2, 3]

Canine impaction elevates the hazard of cyst formation, infection as well as settlement of long-term prognosis of nearby lateral incisor due to their root resorption. Moreover a morbid complexities manifested as referred pain, lack of dental arch length and others.[4, 2]

Althoughthe optimal treatment choices for the emendation of canine impaction is those options with long-term prognosis which are to get these teeth in collocation. For that reason careful localization and assortment of impacted cuspid is mandatory to manage them in best way. The initial stage of handling is accurate revealing of presence of an impacted maxillary cuspid. [1, 5, 6, 3] Precise examination of the neighboring anatomical structures is entailed for localizing an impacted tooth. [7, 8]

Regarding the diagnosis and treatment planning, the most usual imaging means,

was classic bi-dimensional radiographs by which the semblance of the long axis and the relevance with the adjacent dental and bony structures were not delicate due to superposition of these complex structures in the maxillofacial area. Image disfigurement projection mistakes, blurred radiographs; also complex maxillofacial projection onto a bi-D level could decrease the precision and effectiveness, and elevate the hazard of misconstruction of the radiograph. [8, 9]

Therefore CT was employed for similar conditions, to localize the impactions and assessment of resorption of incisors, because of superior tissue contrast and accurate granted tri-D radiographs. [7, 10, 11, 12, 13]

CBCT concerning canine impaction has diagnostic potency and may impact on organizing the treatment, in addition it is possible to do a suggestive remediation for the resorption of the roots of incisors. [14] In addition CBCT does not distort radiographs of impacted teeth. [8]In contrast to conventional CT it offers a volumetric radiographs at raised spatial resolution with a decreased dose of radiation for the dental arch, the 3D radiography offers the information in depth width and length. [15]

In the current study, the use of CBCT images is for evaluation of maxillary impacted canine.

(1) Master Student, Department of Oral and Maxillofacial Radiology, College of Dentistry, University of Baghdad.

(2)Assist.Professor, Department of Oral and Maxillofacial Radiology, College of Dentistry, University of Baghdad.

SUBJECTS AND METHODS

(33) Iraqi subjects (17 males and 16 females) with an age range (13-27 years), were referred to the Oral and maxillofacial radiology department / Al-Wasitti general hospital in Baghdad city, from (November/2015 till April/2016) to have CBCT imaging for localization of maxillary impacted canines. 50 cases of maxillary impacted canines were found (22 in females and 28 in males), involved both bilateral and unilateral impactions.

All patients participated in the study were informed about it and they were asked to sign an informed consent form before undergoing the examination.The clinical examination included the intraoral examination of each patient in order to meet the selective criteria of the sample. The patients should be without history of orthodontic treatment or orthognathic surgery, no history of dentofacial deformities, pathological lesions at the examined area of the jaw or facial trauma, no gross distortion of dental arches due to cleft lip/palate and with good medical history and no hormonal disturbances. The CBCT machine CS 9000 3D Extraoral Imaging System-CareStream dental, was used to obtain the measurements of selected Variables which were:

1.Impacted maxillary canine localization:in 3D images to show the presence or absence of maxillary canine (fig. 1). The relative position of the impacted maxillary canine was classified to5 basic localization described by Fragiskos[16].

2.Angulation:the angle between long axis of tooth and the mid-sagittal plane, (Vertical angulation) & the angle between the long axis of tooth and occlusal plane(horizontal angulations),as described by Al-Ansari et al. [17]in axial and coronal view (fig.2, 3).
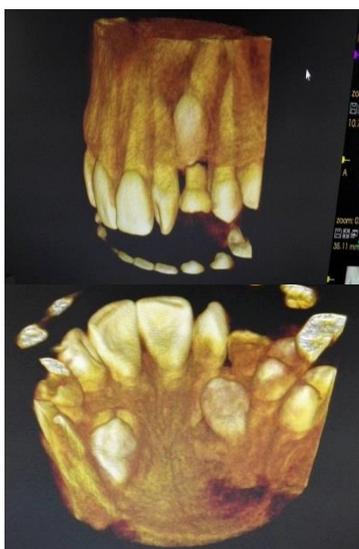

Figure 1:Impacted maxillary canine localization.
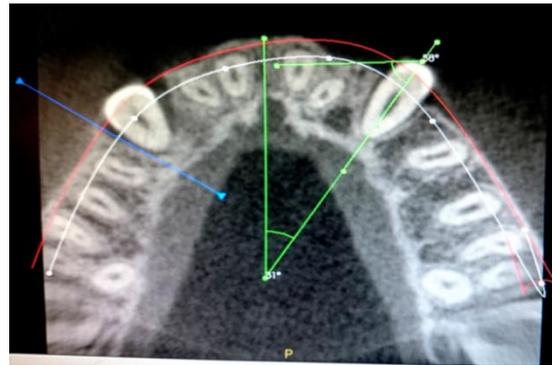
Figure 2: measurement of vertical and horizontal angulation, axial view

Figure 3: Vertical and horizontal angulation measurement, coronal view.

3.Cusp tip distance : The distance from the tip of cusp to occlusal plane line, in coronal view(fig.4)
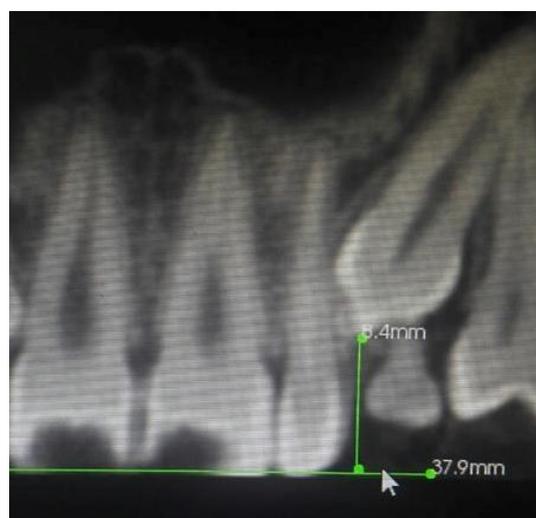

Figure4: Cusp tip distance measuremet.

4.Rootresorption of adjacent teeth:in sagittal view, based on the grading systemsuggestedby Ericson et al. [18]:no, mild, moderate and severe resorption.

5. Alveolar width (in millimeters): mean widtharound the tooth(fig.5),in sagittal view.[19]

Figure5: Alveolar width measurement.

6. Proximity to adjacent teeth: Sagittal view,the alveolar width determines the proximity,described byEricson et al. [18]: no contact or contact.

RESULTS

56% of the patients were males and 44% females. Age range (13-27years) was divided to 3 groups were: (13-15, 16-20, 21 years -older).Impacted canine tooth localization was found in the study was:Labial localization, labial localization of crown and palatal localization of root, palatal localization and Palatal localization of crown and labial localization of root.Labial localization had the highest percentage (42%), while least (4%) for palatal localization crown and labial localization root, none was found as ectopic localization. The highest percentage of the study sample unite did not have root resorption forming (56%) of total cases. The remaining had mild and moderate resorption, none showed severe resorption. A significant statistical relation was found between the impacted canines in contact or

touch with the neighboring teeth and those without contact(table 1). Both vertical or horizontal angulation measurement in axial view, was not possible for a number of the cases,exceeded half of the sample (table2); a single case of measuring vertical angulation in coronal view and another case of measuring horizontal angulation in axial view did not have an angulation with the mid-sagittal and occlusal plane respectively. Comparison of the 2 views validity in measurement of vertical angulation showed a higher mean of angulation calculated in coronal than axial view and a significant statistical difference between the 2. A higher mean of horizontal angulation measurement was found in axial than coronal view with a significant difference between the 2 views. Correlation of the four impacted canine localizations found with the measurements showed a significant statistical difference only with age and vertical angle (coronal view) (table3). No mentionable statistical difference for gender or age with the measurements, except between age and vertical angulation (coronal view)(table 4).

Table 1: Association between the anatomical proximity of the impacted canine to the nearby teeth and their root resorption

	Touching nearby teeth					
	Negative		Positive		Total	
Resorption	N	%	N	%	N	%
No resorption	25	86.207	3	14.286	28	56.0
Mild	3	10.345	13	61.905	16	32.0
Moderate	1	3.448	5	23.809	6	12.0
Total	29	100.0	21	100.0	50	100.0

None had severe resorption; P (Mann-Whitney) = 0.012[S]

Table 2: The relative frequency of cases whom the measurements of the vertical angulation and horizontal angulation in axial section was technically not feasible

	N	%
Vertical angulation in axial section-validation		
Can not be measured	29	58.0
Measurable	21	42.0
Total	50	100.0
Horizontal angulation in axial section-validation		
Can not be measured	30	60.0
Measurable	20	40.0
Total	50	100.0

Table 3: Association between impacted canine tooth localization and measurements

	Impacted canine tooth localization				
	palatal localization	palatal localization of crown, labial localization root	labial localization crown, palatal localization root	labial localization	P (ANOVA)
Age (years)					**0.005 [S]**
Range	(13 to 27)	(14 to 25)	(13 to 27)	(13 to 21)	
Mean	18.4	19.5	18	14	
SD	4.19	7.78	5.11	2.22	
SE	1.16	5.5	1.37	0.49	
N	13	2	14	21	
Vertical angulation in coronal section					**0.008[S]**
Range	(24 to 64)	(25 to 31)	(26 to 88)	(18 to 60)	
Mean	41.9	28	45.8	31.2	
SD	11.59	4.24	17.68	10.04	
SE	3.21	3	4.9	2.19	
N	13	2	13	21	

Table 4: Association between age and vertical angulation

	Age group (years)			
	13-15	**16-20**	**21+**	**P (ANOVA trend)**
Vertical angulation in coronal section				0.012[S]
Range	(18 to 60)	(24 to 64)	(30 to 88)	
Mean	34	39.4	47.4	
SD	11.48	12.62	19.31	
SE	2.17	3.64	6.44	
N	28	12	9	
r=0.389 P=0.006				

DISCUSSION

Maxillary cuspidsare the perfect alternative preservation of the occlusal outline, they are the principle agent in the permanence and esthetics of the dental arch. [20] Accurate diagnosis and localization are needed for the several handling means of the impacted caninewhich involve surgical disclosure then orthodontic induced eruption later.[13] In dentistry obtaining volumetric images of the dental arch and the allaround tissues at a decreased dose of radiation and raised spatial resolution is permitted by CBCT utilization. [21]

This study agreed with findings of a study by Al-Ansari et al.[17], that there's a remarkable link of contacting the impacted canine to the nearby teeth and their root resorption. As this study, they also revealed that all the resorption conditions occurred in group of positive touching.Uday et al. [19] had demonstrated the same, except that larger number of mild resorption cases happened in negative contact group, may be due to different sample size. Alqerban et al. [9], reported a familiar findings specified that following the diagnosis of root resoption of adjacent teeth was determined, the splitting of impacted maxillary canine and the nearby incisors should be instant and, to pause the resorption procedure.

In this study 21 cases of vertical angulation measurement as well as 20 cases of horizontal angulation measurement could not be obtained in the axial section respectively. These results were also recognized by Uday et al.[19], who reported that in order to gain the longitudinal axis of the tooth and for multiple sorts of impaction if various sections were utilized then it is substantial to direct the angulation to the mid-sagittal plane.

Due to parallelism with the mid-sagittal plane and occlusal plane respectively, 2 cases of angulation measurement:vertical angle in coronal view (vertical impaction) and horizontal angulation in axial view (horizontal impaction) could not be obtained, this in accordance to Al-Ansari et al. [17]and Archer [23].

In this study there was a statistically significant difference in vertical angulation value for coronal than axial section, (P=0.002). A study done by Uday et al. [19] did not agree with these,they found that the difference between the 2 sections in mean measurement of vertical angulation was not significant statistically. On the

other hand they agreed that there's a higher mean angulation recorded in coronal compared to axial section.In the current study there was a statistical important difference for the axial than coronal view (P>0.001), for the horizontal angulation measurement.

The highest mean of alveolar bone width surrounding the impacted canine was found in this study in cases of palatal crown labial root localization, which come in accordance to with that obtained by Uday et al. [19],the lowest mean found for labial crown palatal root localization;such findings can lead to improvement of surgical approach to make the most suitable window or disclosure of the impacted cuspid by the operator, in order to do appropriate positioning of an orthodontic attachment.There's no statistical significant difference of both genders with all the selected measurements in this study, such result came in agreement with Ericson and Kurol, [24],Elefteriadis[25]Preda et al.[7]. Basically there's a different craniofacial evolution and expansion between both sexes.

REFFERENCES

1. Richardson G and Russell KA. A review of impacted permanent maxillary cuspids--diagnosis and prevention. Can Dent Assoc. 2000; 66(9): 497-501.
2. Crawford LB. Four impacted permanent canines: An unusual case. Angle Orthod. 2000; 70: 484–9.
3. KatiyarRadha, Pradeep Tandon, Gyan P. Singh, Akhil Agrawal, and T. P. Chaturvedi. Management of impacted all canines with surgical exposure and alignment by orthodontic treatment. ContempClin Dent. 2013; 4(3): 371–373.
4. Bishara SE. Impacted maxillary canines: A review. Am J OrthodDentofacialOrthop. 1992; 101: 159–71.
5. Anwar Ayesha, Jan Hameedullah and NaureenSadia. Pakistan Oral & Dental Journal 2008; 28 (1).
6. Bedoya MM and Park JH. A review of the diagnosis and mamagement of impacted maxillary canines. J Am Dent Assoc. 2009;140(12): 1485-1493 .
7. Preda L, Fianza1Á La, Maggio EM Di, Dore1R, Schifino MR, Campani1R, Segu C and Sfondrini MF. The use of spiral computed tomography in the localization of impacted maxillary canines. Dentomaxillofacial Radiology. 1997; 26: 236-205.
8. Maverna R and Gracco A. Different diagnostic tools for the localization of impacted maxillary canines: clinical considerations. ProgOrthod. 2007; 8(1): 28-44.
9. Alqerban A, Jacobs R, Fieuws S and Willems G 2011. Comparison of two cone beam computed tomographic system versus panoramic imaging for localization of imparte maxillary canines and detection of root resorption. Eur J Orthod., 33, 93-102.
10. Chaushu Stella, ChaushuGavriel and Adrian Becker. The use of panoramic radiographs to localize displaced maxillary canines. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology 1999; 88(4): 511-6 .
11. Ericson S and Kurol J. Incisor root resorption due to ectopic maxillary canines imaged by computerized tomography: a comparative study in entracte teeth. Angle Orthodontist 2000; 70: 276-83.
12. Mason C, Papadakou P and Roberts GJ. The radiographic localization of impacted maxillary canines: a comparison of methods. Eur J Orthod. 2001; 23: 25–34.
13. Walker L, Ensico R and Mah J. Three-dimentional localization of maxillary canines with cone-beam computed tomography. Am J OrthodDentofacialOrthop. 2005; 128(4): 418-23.
14. Oana L, Zetu I, Petcu A, Nemtoi A, Dragan E, Haba D. The essential role of cone beam computed tomography to diagnose the localization of impacted maxillary canine and to detect the austerity of the adjacent root resorption in the Romanian population. Rev Med ChirSoc Med Nat Iasi. 2013;117(1): 212-6.
15. Kishnani R and Bharat R. A New Appoaroch in Diagnosis of Palatally Impacted Maxillary Canine in Orthodontic Patient by Cone Beam Computed Tomography (CBCT) -A Case Report. IOSR -JDMS. 2014; 13: 48-51.
16. Fragiskos D. Fragiskos. Oral Sugery. Springer-Verlag Berlin Heidelberg; 2007.
17. Al-Ansari Nadia B., GhaibNidhal H., Al-NaimiShifaaH.. Diagnosis and localization of the maxillary impacted canines by using dental multi-slice computed tomography 3D view and reconstructed panoramic 2D view. J Bagh College Dentistry 2014; 26(1).
18. Ericson S, Bjerklin K and Falahat B. Does the canine dental follicle cause resorptionof permanent incisor roots? A computed tomographic study of erupting maxillary canines. Angle Orthod. 2002; 72: 95-104.
19. Uday N M, PrashanthKamath, Vinod A R Kumar, Arun B R Kumar, RajatScindhia, Raghuraj M B, Rozario Joe. Comparison of axial and sagittal views for angulation, cuspal tip distance, and alveolus width in maxillary impacted canines using CBCT. Journal of Orthodontic Research 2014; 2(1): 22-26.
20. PokornyPaul H., WiensJonathan P. and LitvakHarold. Occlusion for fixed prosthodontics: A historical perspective of the gnathological influence. The Journal of Prosthetic Dentistry 2008; 99(4): 299–313.
21. Pauwels Ruben, JilkeBeinsberger, Bruno Collaert, ChrysoulaTheodorakou, Jessica Rogers, Anne Walker, Lesley Cockmartin, Hilde Bosmans, ReinhildeJacobsRiaBogaerts and Keith Horner. Effective dose range for dental cone beam computed tomography scanners. European Journal of Radiology 2011;81: 267–271.
22. Ericson S and Kurol PJ. Resorption of incisors after ectopic eruption of maxillary canines: A CT study. Angle Orthod. 2000; 70: 415-23.
23. Archer WH. Oral and Maxillofacial Surgery (5thed.). Saunders, Philadelpha, Pa; 1975.
24. Ericson S and Kurol J. Resorption of maxillary lateral incisors caused by ectopic eruption of the canines. A clinical and radiographic analysis of predisposing factors. Am J OrthodDentofacialOrthop. 1988; 94: 503-13.
25. ElefteriadisJN,AthanasiouAE.Evaluationofimpactedcanines bymeansofcomputerizedtomography.IntJAdultOrthod OrthognathSurg. 1996, 11: 257-64.

الخلاصة:

الخلفية:إنطمار الناب العلوي يعتبرحالة معقدة ومطولة عند العلاج. وذلك لكثرة إختلافه في الميلان والموقع وايضا قد يصاحبه نخرالجذورللأسنان المجاورة.إستخدم جهازالاشعة المقطعية ذات الشعاع المخروطي بعد تقييم المخاطرالمترتبة في مقابل فوائد إستعماله. وذلك لرصانته التشخيصية في تقييم موقع الناب المنطمروكشف تأثيراته الموقعية المهمة.

الهدف من الدراسة :تحديد موقع الناب العلوي المطمور باستخدام جهازالاشعة المقطعية ذات الشعاع المخروطي لتقييم الميلان والبعد العمودي عن خط الاطباق وعرض العظم السنخي والقرب من الأسنان المجاورة.

المواد وطريقة البحث : عينة البحث كانت 33مشارك 16اناثو17ذكورحضروالمستشفى الواسطي العام في بغداد-قسم اشعة الفم و الوجه و الفكين للتصوير بالأشعة المقطعية ذات الشعاع المخروطي من تشرين الثاني 2015 إلنيسان. باستعمال جهازCS 9000تم الحصول على صورثلاثية الأبعاد بالاضافة إلصورمقاطع (تاجية, عرضية, جانبية) لإجراءالقياساتالمختارة.

النتائج: قرب الناب المطمورتشريحيا (كونه على تماس) من الأسنان المجاورة كان له تأثيرقوي في نخرجذورها.عدم إمكانية قياس الزاوية العمودية والأفقية في المقطع العرضي في بعض الحالات. مقارنة فاعلية قياس الميلان بين المقطعين التاجي و العرضي, اظهرت وجود فروق احصائية واضحة لصالح المقطع التاجي في قياس الزاوية العمودية, ونفس الفروق لصالح المقطع العرضي في قياس الزاوية الافقية. وجدت علاقة ذات دلالة إحصائية مهمة بين مواقع الناب المطمورالأربعة التي تم تقييمها في الدراسة مع عمرالمشترك وقياس الزاوية العمودية.

الاستنتاج: يتبين وفق المعطيات الدراسة إن إستخدام جهازالأشعة المقطعية ذات الشعاع المخروطي يوفرمعلومات قيمة حول تقييم موقع الناب العلوي المطمورلزيادة توضيح وعلاج هذه الحالات جراحيا وتقويميا.