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Comparative assessment of impacted maxillary canines- opg and cbct study

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Abstract

Aim: The aim of this study is to correlate the position of impacted maxillary canines on orthopantomogram (OPG) to its position on Cone beam computerized tomography (CBCT) in the study subjects.

Materials and method: A sample of 60 subjects in the age group of 13-25 years with unilateral/bilateral impacted canines were selected. Position of the impacted canines were correlated between orthopantomograms (OPG) and cone beam computed tomography (CBCT) images using sector location, angular, linear parameters and root resorption of the lateral incisor adjacent to the impacted canine was assessed.

Results: Significant positive correlation was found between the linear parameters, sector location between the panoramic radiographs and CBCT images.

Conclusion: Sector location of maxillary impacted canines on panoramic radiographs can be used alternatively for locating impacted maxillary canines.

Keywords: Cone beam computed tomography, Impacted canine, Orthopantomogram

Introduction

Maxillary canines play a vital role in establishing an Esthetic facial contour, pleasing smile line, and canine guided occlusion. It is the second most common tooth to get impacted after the third molar. Untreated impacted canines can result in complications such as shortening of the dental arch, follicular cyst formation, canine ankylosis, recurrent infections, pain, internal resorption, and external resorption of the canine and adjacent teeth. Routinely, the first choice of imaging modality is the conventional radiography (Panoramic radiographs) when an impacted canine is suspected. However, with the advent of CBCT, it is possible to precisely position the impacted canines, determine the amount of bone covering it and evaluate the condition of adjacent anatomic structures. However, CBCT exposes the patient to higher levels of radiation, more expensive, the risk-benefit ratio is controversial and the long-term effects are still not known.

This study was conducted to correlate the position of impacted canines on OPG and CBCT to know the reliability of the diagnostic information provided by panoramic radiographs and possibly reduce the need for CBCT images.

Materials and method

The present study was carried out in the Department of Orthodontics and Dentofacial Ortho pedics, Government Dental College & Hospital, Ahmedabad. It was approved by the Institutional ethical ccommittee. For this study, 60 subjects with age ranging from 13-25 years visiting the department of Orthodontics with clinically unerupted maxillary canines were chosen.

Inclusion criteria

- Age group of the selected subjects in the range of 13-25 years
- Unilateral or bilateral maxillary impacted canines
- No history of previous orthodontic treatment.

Exclusion criteria

- Individuals with craniofacial syndromes
- Any history of dental and facial trauma.
- Presence of odontogenic cysts and tumours around the impacted canine.

Selection criteria

Digital panoramic radiographs were taken using Planmeca Scara-3 and the exposure parameters were set at 80 Kvp, 320 mA and 0.37 s. The sector classification of the impacted canine cusp tip and root tip was done according to classification given by Alessandri Bonetti (2009) and Mcs Sherry et al (1992)

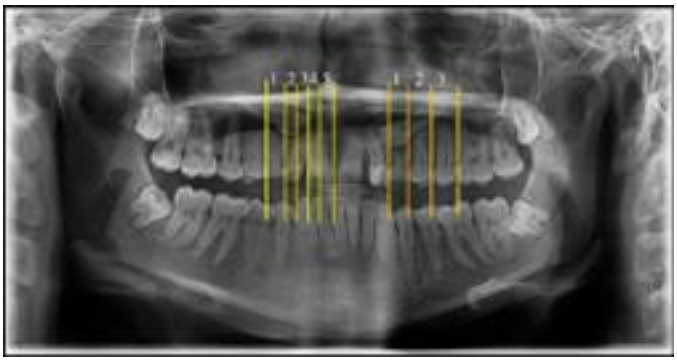


Figure 1: Sector classification of impacted canine crown tip

Sector 1: Corresponds to the deciduous canine.

Sector 2: Indicates the distal aspect of the lateral incisor to the midline of the lateral incisor.

Sector 3: Indicates the midline of the lateral incisor to the distal aspect of the central incisor.

Sector 4: Indicates the distal aspect of the central incisor to the midline of the central incisor.

Sector 5: Indicates the midline of the central incisor to the midline of the maxillary arch.

Sector classification of impacted canine root tip

Sector 1: root apex above the position of the canine

Sector 2: root apex above the first premolar

Sector 3: root apex above the second premolar

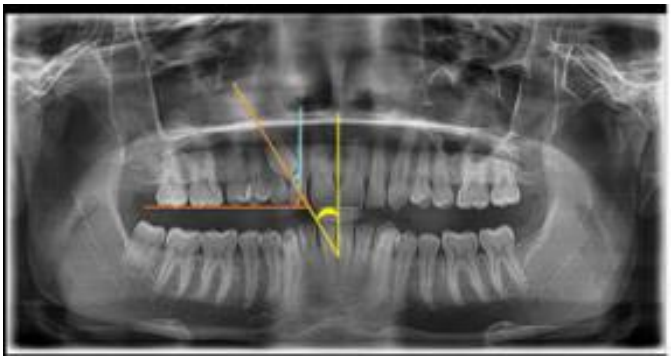
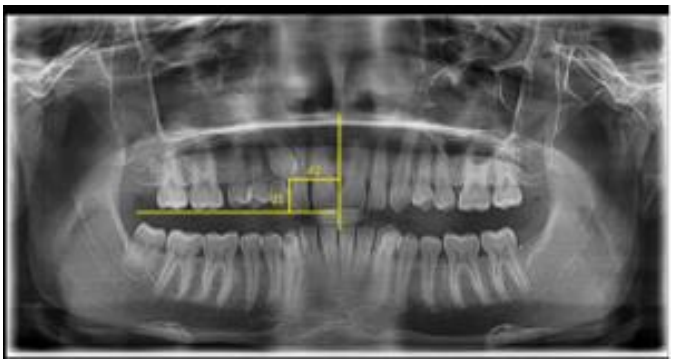


Figure 2: Alpha, beta and gamma angles, vertical distance d1 and horizontal distance d2 on OPG

Alpha angle: The angle formed by the midline of the maxillary arch and long axis of the canine.

Beta angle: The angle formed by the long axis of the impacted canine and the long axis of the lateral incisor.

Gamma angle: The angle formed by the long axis of the impacted canine to the occlusal plane.



d1: The distance measured from the cusp tip of the impacted canine to the occlusal plane.

d2: The distance measured from the cusp tip of the impacted canine to the occlusal plane.

The sector location, angular and linear parameters were measured on the OPG using the Ez-Denti Software.

On CBCT, the following parameters were measured.

α-angle: The angle formed by the midline of the maxillary arch and long axis of the canine in the coronal view.

β-angle: The angle formed by the long axis of the impacted canine and the long axis of the lateral incisor in the sagittal view

γ-angle: The angle formed by the long axis of the impacted canine to the occlusal plane in the coronal view.

Figure 3: Alpha, beta and gamma angles measured in CBCT

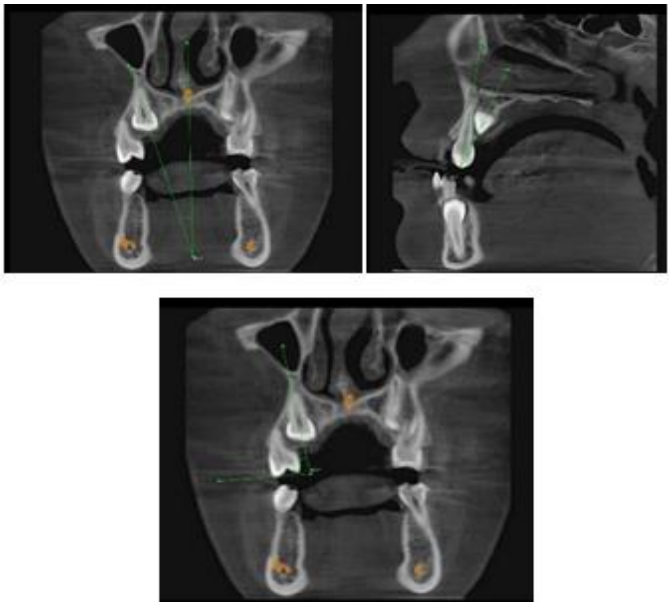


Figure 4: d1and d2 measured in CBCT

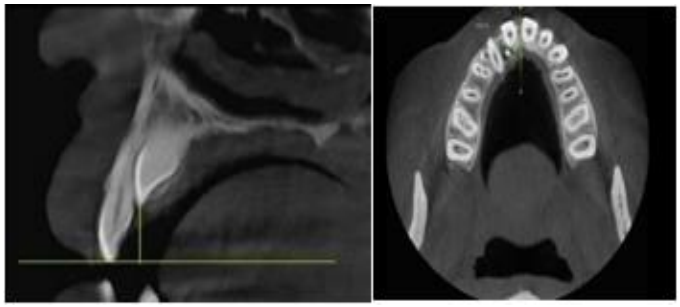
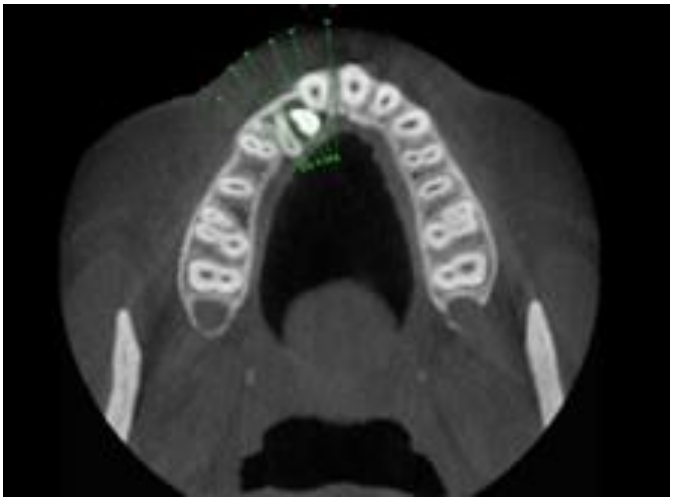


Figure 5: Sector classification done in axial view in CBCT using Alessandri's classification



Results & Discussion

The Normality tests, Kolmogorov-Smirnov and Shapiro-Wilks tests results reveal the study followed normal distribution. To analyse the data, parametric test is applied. Unpaired t-test was done to assess and compare the mean values and Pearson correlation analysis was done to assess the association between the variables in the study. To analyse the data, SPSS (IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY: IBM Corp. Released 2019) software is used. Significance level is fixed as 5% ($\alpha = 0.05$).

Table 1: Distribution of impacted maxillary canines based on labiopalatal position

Position of canine	Female	Male	Total	p-value
Labial	16	11	27	0.53
Mid-alveolus	4	6	10	
Palatal	23	14	37	
Total	43	31	74	

Table 2: Correlation of vertical distance d1 and horizontal distance d2 of maxillary impacted canines on occlusal plane in OPG and in CBCT

Variables	Mean (mm)	Correlation (r)	P-Value
OPG-d1	13.07 ±6.04	0.745	<0.01*
CBCT-d1	12.89 ± 5.73		
OPG-d2	8.11 ± 4.64	0.861	<0.01*
CBCT-d2	7.77 ±4.56		

Table 3: Correlating sector location of impacted maxillary canines on OPG to its labiopalatal position on CBCT

Sector location in OPG	Labiopalatal position in CBCT			Correlation (r)	P-value
	Labial	Mid alveolus	Palatal	0.742	0.01*
Sector 1	12	1	3		
Sector 2	7	4	4		
Sector 3	3	3	7		
Sector 4	2	0	8		
Sector 5	3	2	15		

Table 4: Alpha, Beta and Gamma angle correlation of maxillary impacted canines between OPG and CBCT

Variables	Mean	SD	Correlation (r)	P-value
OPG-alpha	41.09°	22.87°	-0.32	<0.02*
CBCT-alpha	36.62°	21.29°		
OPG-beta	45.48°	24.32°	-0.41	<0.01*
CBCT-beta	41.74°	23.78°		
OPG-gamma	45.37°	18.69°	-0.12	<0.02*
CBCT-gamma	39.53°	18.24°		

Table 5: Correlation between sector location of impacted maxillary canines on OPG and sector location in CBCT.

Sector location in OPG	Root resorption in CBCT		Correlation (r)	P-value
	Resorption	No resorption	0.934	0.003*
Sector 1	2	14		
Sector 2	3	12		
Sector 3	10	3		
Sector 4	8	2		
Sector 5	17	3		

Table 6: Correlating sector location of root tip of impacted canine on OPG to labiopalatal position of crown on CBCT

Sectors In OPG	Labiopalatal Position in CBCT			Correlation (r)	P-Value
	Labial	Mid-alveolus	Palatal	-0.316	
SECTOR 1	10	2	8		0.041*
SECTOR 2	12	7	19		
SECTOR 3	5	1	10		

Table 7: Correlating sector location of impacted maxillary canines (OPG) to resorption of maxillary lateral incisor roots

Variables	OPG	CBCT
Mean	2.7763	2.5395
SD	1.44774	1.28001
Correlation (r)	0.958	
P-value	<0.01*	

Table 8: Correlating labiopalatal position of impacted maxillary canine to resorption of roots of maxillary lateral incisor

Labio-palatal position in CBCT	Root resorption in CBCT		Correlation (r)	P-value
	resorption	no resorption	0.726	<0.01*
Labial	13	14		
Mid-alveolus	2	8		
Palatal	25	12		

Table 1 shows that from 74 impacted maxillary canines, 27 were labially impacted (36.4%), 10 were mid-alveolus impacted (13.6%) and 37 were palatally impacted (50%). This finding is in accordance with Jacoby et al[1], Shapira et al[2], Ericson et al[3], Walker et al[4], Thilagavathy et al[5], Schindel et al[6], Johnston et al[7], Quadras et al[8], Bjerklin et al[9] who reported majority of the impacted canines to be located palatally. The difference between labially, palatally and mid-alveolar placed canines was statistically non-significant. Table 2 shows that the mean value of d1 (the distance measured from the cusp tip of the impacted canine to the occlusal plane) on OPG is 13.07 mm ± 6.04 mm and on CBCT is 12.89 mm ± 5.73 mm. A strong positive correlation exists between d1 measured on OPG and CBCT (r=0.745) and this correlation is statistically significant (p<0.01). The mean value of d2 (The distance measured from the cusp tip of the impacted canine to the occlusal plane) on OPG is 8.11 mm ± 4.64 mm and on CBCT is 7.77 mm ± 4.56 mm. A very strong positive correlation exists when d2 is measured both on OPG and CBCT (r=0.861). This correlation is statistically significant (p<0.01) respectively indicating that not much variation is observed in linear measurement both on OPG and CBCT. This finding is in accordance with the study conducted by Mohammed et al[10] who observed

statistically significant correlation (r=0.836, p<0.01) for d1 and (r=0.835, p<0.01) for d2. Statistically significant correlation was found between the sector location of the impacted canine on OPG and their labio-palatal position on CBCT (Table 3) and it is strongly positive (r=0.742, p=0.01). Majority of the impacted canines are found in sectors 3, 4 and 5 which is in accordance with Jung et al[11], Lindauer et al[12], Warford et al[13] who reported that 63% of the maxillary canine impactions were found in sectors 3,4 and 5. Mean value of alpha angle obtained in OPG is 41.09° ± 22.87° and CBCT is 36.62° ± 21.29° (Table 4). Weak negative correlation is observed between them (r= - 0.32) and that this correlation is statistically significant (P<0.02). The mean values of the beta angle on CBCT are less than that of the value obtained on OPG. Moderate negative correlation is observed between them (r= -0.41) and that this correlation is statistically significant (P<0.01). This is in accordance with the study conducted by Akkuc et al[14] who also observed statistically significant difference between the beta angles on OPG and CBCT (p<0.01) with the mean values of 39.62° ± 13.81° and 34.31° ± 16.84° on OPG and CBCT respectively. The mean value of gamma angle in OPG is 45.37° ± 18.69° and in CBCT is 39.53° ± 18.24°. Weak negative correlation was observed between the gamma angles in OPG and CBCT (r= -0.12) and the correlation between them is statistically significant (p=0.01). This is in contrast to the study conducted by Sarikir et al[15] who observed statistically significant differences between them (p<0.01) with the mean values of 45.99° ± 28.20° and 49.79° ± 19.35° in OPG and CBCT respectively. Table 5 shows strongly positive and statistically significant correlation between the sector locations on OPG and CBCT (r=0.958, p<0.01). This is in accordance with the study conducted by Bjorksved at al[16] who observed a fair agreement between the two groups (k=0.36, p<0.01). Table 6 shows a weak negative correlation between the sector location of root tip & labio-palatal position of the impacted maxillary canine crown (r=-0.31) which is statistically significant. This is in contrast with the study conducted by Kim et al[17] who observed a statistically significant positive correlation between the sector location of the root tip and labio-palatal position of the impacted canine (p<0.001). This could reflect ethnic difference as the above-mentioned study was done in Korean population. Table 7 shows statistically significant correlation between the sector location on OPG and resorption observed in axial and sagittal views in CBCT which was strongly positive (r=0.934, p=0.003). Majority of the resorption are observed in sectors 3, 4 and 5 (70%) and majority of the non-resorbed canines are found in sectors 1 & 2. This is in accordance with Jung et al[11] who observed resorption in the maxillary lateral incisor root in sectors 3, 4 and 5 (30.1%), Akan et al[22] who observed resorption in maxillary lateral incisor root in sectors 2,3 and 4 (39.2%), Schindel et al[6] reported maxillary lateral incisor root resorption in sectors 3,4 (43.75%). Of the total 37 palatally impacted canines, 25 showed adjacent lateral incisor root resorption in the apical third and 12 showed no resorption of adjacent maxillary lateral incisor root (Table 8). This is in accordance with Brin et al[18] who observed that resorption was predominant in palatally impacted canines (86%). Similar result was observed in the study done by Rimes et al[19] who reported 43.8% of adjacent lateral incisor root resorption in palatally impacted canines. This finding is in contrast with the study conducted by kim et al[17] and Zhong et al[21] who observed buccal canine impactions have more tendency to cause adjacent teeth root resorption (49.5%). Ethnic diversity could be the reason for this.

Conclusion

- Palatally impacted canines were more common (50%) followed by buccally impacted canines (36%) and mid-alveolar impacted canines (13%).
- Sector 1 and Sector 2 predominantly have labially impacted canines and sector 4 and sector 5 showed predominance of palatally impacted canines. This suggests that sector location can be used to determine position of impacted canines.
- Increased tendency of root resorption of lateral incisors was observed in palatally impacted canines. Therefore, CBCT is recommended in these cases for treatment planning.
- Increased sample size and gender discrimination would be more conclusive.

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