International Journal of Scientific Research in Dental and Medical Sciences

www.ijsrdms.com

Accuracy of Panoramic Radiography in Assessing the Labio-palatal Position of Maxillary Impacted Canines and Root Resorption of the Adjacent Tooth

Zahra Sadat Tabatabaei Jebeli[a,*], Mehdi Rafiei[b], Azadeh Torkzadeh[c]

[a] *School of Dentistry, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran*
[b] *Department of Orthodontics, School of Dentistry, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran*
[c] *Department of Oral and Maxillofacial Radiology, School of Dentistry, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran*

ARTICLE INFO

Article history:
Received 21 October 2020
Received in revised form 29 November 2020
Accepted 08 December 2020
Available online 14 December 2020

Keywords:
Canine tooth
CBCT
Impacted tooth
Panoramic radiography
Root resorption

ABSTRACT

Background and aim: Determining the accuracy of panoramic radiography in assessing the labio-palatal position of maxillary impacted canines and root resorption of the adjacent tooth.

Materials and methods: We used these further variables: angulation, mesiodistal position, and vertical position, which respectively were based on the angulation of canine about the midsagittal plane, five sectors on panoramic radiographs using the Allcandri method, and division of incisor adjacent to the impacted canine into three sectors. labio-palatal position of the MICs and root resorption of permanent incisors were evaluated on CBCT. The statistical correlation between the investigated variables on panoramic and position of MICs and the root resorption of the adjacent tooth on CBCT were examined using independent t-test, Mann-Whitney test, and Fisher's exact test.

Results: In respect of the mesiodistal position of the cusp tip of the MIC, the labially localized MICs were common in sectors 1 and 2, and the palatally localized MICs were more frequent in sectors 3, 4, and 5. Concerning the vertical position of the MIC's cusp tip, the localized labial MICs were more common in sectors 1 and 3, and palatally localized MICs were more frequent in sector 2. The mean angle of MICs about the sagittal plane was significantly higher in the palatally localized MICs. There was no significant correlation between the MIC's tip, mesiodistal position, and the adjacent tooth's root resorption.

Conclusion: Results showed the correlation coefficients among the upper pharyngeal airway width, and ANB and Witt's analyses were not significant. These results can reinforce the probability of class III malocclusion inheritance.

1. Introduction

An impacted tooth is defined as a tooth embedded completely or incompletely in the jawbone or mucosa for more than two years after the physiological eruption time.[1] With a 1 to 3% prevalence, the maxillary canine is the second most common tooth to remain impacted after the third molar.[1, 2] Generally, most maxillary impacted canines are palatally rather than buccally.[3] Also, the ectopic eruption of canines or palatally displaced canines are more common in women than men and varies in different races.[3,4] The etiology of impacted canine is multifactorial and still unclear. According to some articles, genetics and environmental factors may play a role in palatally impacted canine.[4] In general, canines play an essential role in establishing a functional occlusion, as well as a beautiful smile.[5] Because the canines are vital in supporting facial muscles, their positions are influential in the person's appearance. In addition to the role of canines in chewing, which is essentially tearing food, they have the largest combination of crown and root length in each arc, and their roots are very firmly located in the alveolar bone. They are the strongest teeth in the mouth due to the thick alveolar bone and root length. Many experts believe that the maxillary canines direct the mandible to the central position by preventing other opposite teeth from coming into contact until they meet in the central occlusion.[6] Early detection and exact localization of a maxillary impacted canine (MIC) are important to avoid complications such as root resorption of adjacent teeth, affected canine ankylosis, or cystic lesion formation.[2] Correct localization of the MIC and its relationship to the teeth and adjacent anatomical structures is essential for successful orthodontic treatment.[2,7] This information can only be fully provided by radiographic imaging.[8] Radiography is required to expose the impacted canine in three planes (vertical, mesiodistal, buccopalatal) and show its relationship to the midline and adjacent teeth and examine any resorption.[9] Conventionally, palatally

* *Corresponding author. Zahra Sadat Tabatabaei Jebeli*
E-mail address: ztabatabaei2@gmail.com
School of Dentistry, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran
http://doi.org/10.30485/IJSRDMS.2020.254092.1093

impacted canine detection has been based on panoramic or periapical radiography.[10] Diagnostic information obtained from panoramic radiography is valuable for primary examination, prognosis, dental eruption follow-up, and treatment outcomes.[11] Many preliminary consultations currently include panoramic radiography in the routine orthodontic treatments, and any impacted canine is a notable finding on the panoramic radiography. There are many benefits in having this graph alone to localize the impacted tooth. These films are utilized in most patients undergoing orthodontic therapy, and usually, there is no need for another film.[12] Some previous studies concluded that cone-beam computed tomography (CBCT) employment leads to significant differences in the treatment plan for the unerupted maxillary canine. In contrast, other studies reported that it is not significantly different from conventional radiographs. In assessing the canal root resorption, the SEDENTEXCT project declares that no credible evidence supports the application of CBCT as first-line imaging, and it is not cost-effective in this case.[8] The ALARA principles and SEDENTEXCT guidelines declared that the CBCT examinations should not be used indiscriminately but should be recruited in exceptional cases where routine radiography may not provide sufficient diagnostic information.[5] Nagpal et al. determined the canine- incisor index, canine-canine index, control canine-incisor index, and vertical position (apical, middle, coronal), mesiodistal sectors (1, 2, 3, and 4) on digitized panoramic radiographs. They aimed to find a reliable strategy to localize the MICs on a single panoramic radiograph and determine its validity and reproducibility. The result of their study was the unreliability of the panoramic radiograph in MIC localization. It was stated that the impacted canines could not be positioned by panoramic radiography alone.[12] On the other hand, Kok Ti Tu Ngo et al. and Atsha Kanvar et al. demonstrated that the labio-palatal position of impacted canine and the root resorption of permanent incisors might be predictable using the cusp tip of impacted canine on the panoramic radiology.[5,13] Besides lately, Shaimaa Elmarhoumy et al. and WafaAlfaleh et al. compared the labio-palatal position of maxillary impacted canines (MICs) on CBCT and their mesiodistal position on panoramic radiographs. They concluded that sector location on panoramic radiographs might be used for prediction of labiopalatal position of MICs.[14, 7] The results of previous studies have been contradictory regarding the feasibility of using panoramic radiography alone to detect the buccopalatal position of the impacted canine and the extent of root resorption of the adjacent teeth. Due to the above' clinical significance, the present study aimed to determine the accuracy of panoramic radiography in assessing the maxillary impacted canine's buccolingual position and the adjacent teeth' root resorption.

2. Materials and methods

This study was carried out with the approval of the ethics committee IR.IAU.KHUISF.REC.1398.202 of Islamic Azad University, Khorasgan Branch, and the school of Dentistry's relevant officials at this University. This descriptive-analytical cross-sectional study was conducted on a study population consisted of orthodontic patients with MICs who underwent pre-treatment CBCT and panoramic radiography. In 2019, patients with an impacted canine referred to Islamic Azad University of Isfahan, Khorasgan Branch, were selected by convenience sampling method. The sample size was estimated at 60 by similar articles,[4] and the sample size calculation formula was which n is equivalent to 30.

$$n_1 = n_2 = \frac{(z_{1-\alpha/2} + z_{1-\beta})^2 [p_1(1-p_1) + p_2(1-p_2)]}{(p_1 - p_2)^2}$$

Thus, 60 orthodontic patients with unilateral or bilateral MICs, who underwent pre-treatment CBCT scan and panoramic radiography, were included in this study. The interval between panoramic radiography and CBCT was no more than six months, all had been prepared by the same device. The teeth that were completely or incompletely embedded in the jawbone or mucosa for more than two years after the physiological eruption time were considered impacted teeth. A total of 66 teeth were finally examined. Exclusion criteria were the patients with poor quality panoramic radiography or CBCT scans, types of syndromes, history of dental trauma, odontogenic tumors or cysts around impacted canines, ectopic canines, cleft palate, history of orthodontic treatment, or panoramic radiographs and CBCT scans which were taken more than six months separately. The panoramic images and CBCT scans of patients have been reviewed. We made sure to examine the panoramic images before the CBCT images. The localization of the MIC's cusp tip about adjacent incisors was divided into five sectors on panoramic radiographs using the Allcandri method.[4]

The mesiodistal position of the cusp tip of the MIC on the panoramic radiographs was as follows: sector 1: the area at the distal aspect of the tangent line to the distal aspects of the leading edge of lateral incisor crown and root canal; sector 2: the area that is limited to the sector one and the long axis of the lateral incisor; sector 3: the area defined by the sector two and the line tangent to the mesial aspect of the crown and the root of the lateral incisor; sector 4: the area that is limited to the sector three and the long axis of the central incisor; and sector 5: the area that is limited to the sector four and the maxillary central inter median incisor line (Fig. 1). Moreover, we determined the angulation of the canine about the midsagittal plane and its correlation with the extent of root resorption of the adjacent teeth and the palatal or buccal position of the canines. Another factor examined in this study on the panoramic radiography was the vertical position of the cusp tip of the MIC to the adjacent erupted incisor. To this end, the incisor adjacent to the impacted canine was divided into three sectors: sector 1: the coronal region of the root of the adjacent incisor, defined as the coronal plane; sector 2: the apical region of the root of the adjacent incisor, defined as the midsagittal plane, and sector 3: the region beyond the apex of the adjacent incisor, defined as the apical plane. Finally, we examined the correlation between the impacted canine's vertical position and the extent of root resorption of the incisors, and the palatal or buccal position of the canine (Fig. 2).

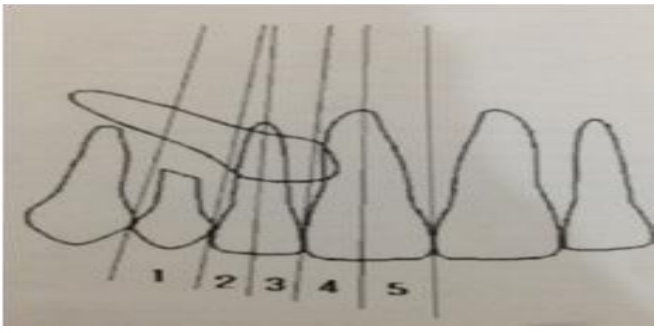

Fig. 1. Mesiodistal position of the cusp tip of the canine and adjacent teeth for the localization of the sectors on the panoramic radiography.

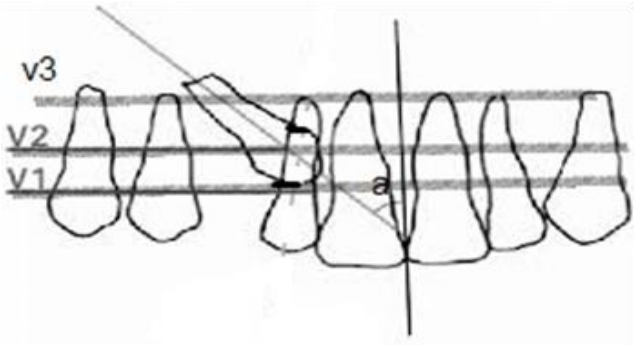

Fig. 2. a: Angle of the long axis of the canine to the midsagittal plane. V: Different sectors of the vertical plane.

The labio-palatal position of the MICs and the root resorption of maxillary incisors were evaluated on the modified static CBCT cross-sectional images. Root resorption of permanent incisors was classified as resorbed or non-resorbed. The coronal position of the impacted canine was divided into labial or palatal. The localization on the panoramic radiography was compared with the labio-palatal position of MICs, as well as the possibility of root resorption of incisors on the CBCT .To increase this assessment's validity and reliability, all of the panoramic and CBCTs were obtained from one device. In all panoramic radiographs and CBCT images, the patient's identity was hidden and randomly displayed for evaluation. Statistical analysis was performed at both descriptive and inferential levels. Mean, standard deviation, frequency distribution tables, and statistical graphs were used in the descriptive analysis. Independent t-test, Mann-Whitney, and Fisher's exact tests were employed in the inferential analysis to answer the research objectives. Analyzes were performed at a significance of 5% using SPSS version 22 software.

3. Results

Among 66 investigated teeth, 35 teeth (53%) were located in the buccal, and 31 teeth (47%)were located in the palatal. The adjacent tooth's root resorption was not observed in 51 teeth (77.3%) and present in 15 teeth (22.7%).

Table 1. Correlation between the vertical position of canines on panoramic radiography and labio-palatal position of teeth on CBCT scan.

Vertical positions	Labio-palatal positions				p-value
	Buccal		Palatal		
	Frequency	Percentage	Frequency	Percentage	
1	25	71.4	12	38.7	0.001
2	6	17.1	18	58.1	
3	4	11.4	1	3.2	
Total	35	100.0	31	100.0	---

As seen in Table 1, Fisher's exact test results showed a significant correlation between the canines' vertical position and labio-palatal position ($p<0.001$). The localized buccal MICs on the CBCT scans were more common in the vertical position of sectors 1 and 3, and the palatal localized MICs on the CBCT scans were more frequent in the vertical position of sector 2 ($p<0.001$).

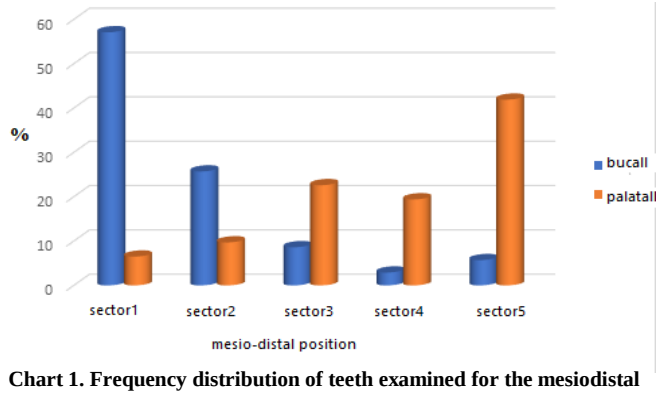

Chart 1. Frequency distribution of teeth examined for the mesiodistal position of canines on panoramic radiography and labio-palatal position of teeth on CBCT scan.

Fisher's exact test results revealed a significant correlation between mesiodistal position and labio-palatal position of canines ($p<0.001$). Most of the localized buccal MICs on the CBCT scans were in the mesiodistal positions 1 and 2. The palatal localized MICs on the CBCT scans were more common in the mesiodistal positions 3, 4, and 5 (Fig. 1).

Table 2. Comparison of the mean angle of the canine about the labio-palatal position of the canine.

Labio-palatal position	Frequency Of teeth	Minimum angle	Maximum angle	Mean	Standard deviation	Statistics	P-value
Buccal	35	2.00	73.00	27.29	15.40	-3.464	0.001
Palatal	31	12.00	101.10	41.70	18.39		

According to Table 2, the independent t-test result indicated a significant difference in the canine's mean angle about the midsagittal plan in the buccal and palatal positions ($p<0.001$). The mean angle of the canine about the midsagittal plan was significantly higher in the palatal localized MICs.

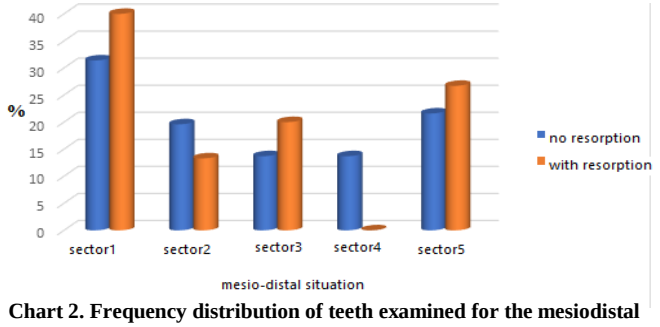

Chart 2. Frequency distribution of teeth examined for the mesiodistal position of canines on panoramic radiography and root resorption of adjacent teeth on CBCT scan.

As seen in Chart 2, Fisher's exact test results showed no significant correlation between mesiodistal position and root resorption of adjacent teeth ($p=0.600$).

Table 3. Correlation between the vertical position of canine on panoramic radiography and root resorption extent of adjacent teeth on CBCT scan.

Vertical positions	Root resorption				p-value
	No		Yes		
	Frequency	Percentage	Frequency	Percentage	
1	30	58.8	7	46.7	0.736
2	17	33.3	7	46.7	
3	4	7.8	1	6.7	
Total	51	100.0	15	100.0	---

According to Table 3, Fisher's exact test results found no significant correlation between the vertical position and root resorption of adjacent teeth (p=0.736).

Table 4. Comparison of the mean angle of canine based on the root resorption extent of adjacent teeth.

Root resorption	Frequency	Minimum	Maximum	Mean	Standard deviation	Statistics	P-value
No	51	2.00	101.10	33.00	18.41	324.50	0.357
Yes	15	14.00	80.00	37.65	17.77		

According to Table 4, the Mann-Whitney test results showed no significant difference in the angle of canine about the midsagittal plane in resorbed or non-resorbed adjacent teeth (p=0.375). As a result, there is no correlation between the angle of canine and the root resorption of adjacent teeth.

4. Discussion

The exact localization of impacted teeth plays a key role in providing appropriate surgery access or determining the right direction to apply orthodontic forces.[15] Panoramic radiography has been considered for many years as the standard technique for detecting and treating impacted canines[13] Previous studies confirmed the use of panoramic radiography in the localization of MICs and the prediction of root resorption. It is beneficial to use the maximum volume of information from a single panoramic radiograph without further imaging, as it reduces unnecessary radiation to the patient.[13] This study showed that some panoramic radiography parameters could increase the diagnostic accuracy for localization of impacted canine. Still, no parameters were found that could increase the accuracy of root resorption detection. The present study investigated the role of three parameters, including angulation, mesiodistal position, and vertical position of impacted canine about the midsagittal plane, in increasing the accuracy of panoramic radiology to detect the labial or palatal position of this tooth and the root resorption extent of adjacent teeth. Fisher's exact test results showed a significant correlation between the mesiodistal position of the cusp tip of the impacted canine and the labio-palatal position of this tooth (p<0.001). The localized buccal MICs in CBCT were more common in the mesiodistal positions 1 and 2, and the palatal localized MICs were more frequent in the mesiodistal positions 3, 4, and 5. Moreover, this test revealed a significant correlation between the vertical position and labio-palatal position of impacted canines (p<0.001). The localized buccal MICs were common in vertical positions 1 and 3, and the palatal localized MICs were frequent in vertical position 2. The independent t-test results showed a significant difference in the canine's mean angle about the midsagittal plane in the buccal and palatal positions (p<0.001). The canine's mean angle about the midsagittal plane was significantly higher in the palatally localized MICs. The attention to these three parameters seems to increase panoramic radiology's accuracy to localize the impacted canine. Kok Ti Tu Ngo et al. and Atsha Kanvar et al. demonstrated that the labio-palatal position of impacted canine and the root resorption of permanent incisors might be predictable using the cusp tip of impacted canine on the panoramic radiology. These two studies had mesiodistal positioning quite similar to this study.[5, 13] Kok Ti Tu Ngo et al. reported that the impacted canines localized in the distal lateral teeth were more common in the labial position (position 1). Those localized in the area between the tangent line to the distal aspect of the lateral tooth and the line passing through the long axis of the lateral tooth (position 2) were more common in the mid-alveolus position, and the impacted canines localized in sectors 3, 4 and 5 were more frequent in the palatal position.[5] These results were similar to the present study, except that the mid-alveolus position was also examined, which was not investigated in our study. Kok Ti Tu Ngo et al. also stated that the root resorption and the localization of the impacted canine's cusp tip are correlated, with teeth localized in sectors 4 and 5 being associated with the root resorption of the adjacent tooth.[5] This result is inconsistent with our findings. Analysis and comparison of both studies showed that the statistical population in Kok Ti Tu Ngo et al. was 39 teeth with root resorption. In comparison, our study consisted of only 15 teeth with root resorption. It seems that the number of resorbed teeth was inadequate to statistically investigate and find a significant correlation with the three parameters studied. Our study failed to find this correlation. Atha Kanvar et al. revealed that most of the labial localized teeth were in sectors 1, 2, and 3, and the localized palatal teeth were in sectors 4 and 5. The highest diversity of distribution belonged to mid-alveolus canines, with more frequency in sectors 1 and 5. The incisors' root resorption was more common in cases where the impacted canine was in sectors 3, 4, and 5.[13] This study's results were very similar to our findings, with only two differences: the first difference was that our results showed that most of the canines localized in the mesiodistal position three were in the palatal plane. They stated that most of the teeth in sector 3 were in the labial position. To understand the reason for this difference, we looked at their table of results; the results showed that, among the teeth localized in the mentioned area, 6 of them were in the labial position and 5 of them were in the palatal position, indicating that the inference was based on the difference of only one tooth.[13] However, in our study, seven were in the palatal position among the teeth localized in this sector, and only 3 of them were in the buccal position. It seems that the decision of Atsha Kanvar et al. might have been based on a hasty difference. Another reason for their difference from our results could be the small statistical population of localized palatal teeth (26 teeth) in their study. In comparison, the number of localized palatal teeth (31 teeth) was higher in our study. Kok Ti Tu Ngo et al. found results similar to our findings. Of the teeth localized in the mesiodistal sector, 3, 7 were in the labial position and 19 in the palatal position. This could be due to the large number of teeth examined in their study (88 teeth) as well as the large number of palatal localized palatal teeth examined (58 teeth).[5] Bhuvaneshwari et al. also showed that if the parameter of the impacted canine tooth's vertical position is used, the panoramic radiology can be a useful tool in the localization of the impacted canine. The results of their study showed that the MICs localized in the middle zone of the adjacent tooth root are more common in the palatal position than those localized in the coronal zone of the adjacent tooth root.[15] Similarly, we examined the role of the impacted canines' vertical position in the localization of the labially or palatally impacted canine. We came to the same conclusion, except that they made only one general conclusion that the impacted canine's vertical position can increase the accuracy of detecting the labio-palatal position of the impacted canine and that most palatal localized teeth are in the middle zone of the root of the adjacent teeth. They did not take any specific position on the labial position of the impacted canines. Still, our study showed that most of the teeth localized in the coronal sector of the adjacent root (sector 1) and the apical sector (sector 3) are in the buccal position. The reason

that Bhuvaneshwari et al. could not reach a specific localization about the labial position of the impacted canine is their different way of zoning, so that they divided the adjacent tooth root into three sectors: coronal, middle, and apical, while we divided the adjacent tooth root into coronal and middle sectors, and we mean the apical sector beyond the root end of the adjacent tooth. The present study limitations were the difficulty finding the impacted canines on the CBCT provided all by the same device and panoramic radiology, and the larger sample size. Further studies are suggested to find an effective index in detecting root resorption based on panoramic imaging. A statistical population with more root resorption may help obtain useful information to increase the accuracy of panoramic radiography to detect root resorption. A study is also recommended to examine the correlation between the parameters and the impacted canines in the mid-alveolus position. The next study should also be retrograde, and the appropriate number of teeth with root resorption should be found first, and radiographs should be selected where root resorption is observed. It is also better if the next study is retrograde and the radiographs that include teeth with tooth resorption be selected.

5. Conclusion

The results obtained from the present study indicate the importance of three parameters of angulation, mesiodistal position, and vertical position of the impacted canine crown in improving the diagnostic accuracy of panoramic radiography for the localization of impacted canines. Those IMCs located in mesiodistal sectors 1 and 2 and most of those located in the apical or coronal position about the adjacent tooth are buccally positioned impacted canines. On the other hand, most of those vertically located in the middle position of adjacent's tooth root, and those which mesio-distaly are located in the sectors 3, 4, and 5 are more common in the palatal position. Besides, an increase in the mean angle of impacted canine in relation to the midsagittal plane increases the probability of palatally localizing the tooth. This study's results do not support the correlation between the mentioned three parameters and the root resorption of the adjacent teeth.

Conflict of Interest

The authors declared that there is no conflict of interest.

Acknowledgements

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

References

[1] Al-Zoubi H, Alharbi AA, Ferguson DJ, Zafar MS. Frequency of impacted teeth and categorization of impacted canines: A retrospective radiographic study using orthopantomograms. European journal of dentistry. 2017;11(1):117-121. doi: 10.4103/ejd.ejd_308_16.

[2] Lai CS, Suter VG, Katsaros C, Bornstein MM. Localization of impacted maxillary canines and root resorption of neighbouring teeth: a study assessing the diagnostic value of panoramic radiographs in two groups of observers. European journal of orthodontics. 2014;36(4):450-6. https://doi.org/10.1093/ejo/cjt074.

[3] Izadikhah I, Cao D, Zhao Z, Yan B. Different Management Approaches in Impacted Maxillary Canines: An Overview on Current Trends and Literature. The Journal of Contemporary Dental Practice. 2020;21(3):326-36.

[4] Alqerban A, Jacobs R, Fieuws S, Willems G. Comparison of two cone beam computed tomographic systems versus panoramic imaging for localization of impacted maxillary canines and detection of root resorption. The European Journal of Orthodontics. 2011;33(1):93-102. https://doi.org/10.1093/ejo/cjq034.

[5] Ngo CT, Fishman LS, Rossouw PE, Wang H, Said O. Correlation between panoramic radiography and cone-beam computed tomography in assessing maxillary impacted canines. The Angle Orthodontist. 2018;88(4):384-9. https://doi.org/10.2319/103117-739.1.

[6] Sajnani AK. Permanent maxillary canines–review of eruption pattern and local etiological factors leading to impaction. Journal of investigative and clinical dentistry. 2015;6(1):1-7. https://doi.org/10.1111/jicd.12067.

[7] Elmarhoumy S, Gomaa N. Assessment of maxillary impacted canines using panoramic radiograph and cone-beam computed tomography. Egyptian Dental Journal.2020;66(4):2015-2019.DOI: 10.21608/edj.2020.39553.1213.

[8] Christell H, Birch S, Bondemark L, Horner K, Lindh C, SEDENTEXCT consortium. The impact of Cone Beam CT on financial costs and orthodontists' treatment decisions in the management of maxillary canines with eruption disturbance. European journal of orthodontics. 2018;40(1):65-73. https://doi.org/10.1093/ejo/cjx039.

[9] El Beshlawy DM. Radiographic assessment of impacted maxillary canine position using CBCT: A comparative study of 2 methods. Egyptian Dental Journal.2019;65(4):3393-402. DOI: 10.21608/edj.2019.74780.

[10] Eslami E, Barkhordar H, Abramovitch K, Kim J, Masoud MI. Cone-beam computed tomography vs conventional radiography in visualization of maxillary impacted-canine localization: A systematic review of comparative studies. American Journal of Orthodontics and Dentofacial Orthopedics. 2017;151(2):248-58. https://doi.org/10.1016/j.ajodo.2016.07.018.

[11] Alhammadi MS, Asiri HA, Almashraqi AA. Incidence, severity and orthodontic treatment difficulty index of impacted canines in Saudi population. Journal of clinical and experimental dentistry. 2018;10(4):e327.

[12] Nagpal A, Pai KM, Setty S, Sharma G. Localization of impacted maxillary canines using panoramic radiography. Journal of oral science. 2009;51(1):37-45. https://doi.org/10.2334/josnusd.51.37.

[13] Kanwar A. Evaluation of positionof maxillary impacted canine and its effect on adjacent teeth-A correlation study between panoramic radiography and cone beam computed tomography. International Journal of Biomedical and Advance Research 2016; 7(9): 472-476. http://dx.doi.org/10.7439/ijbar.

[14] Alfaleh W, Al Thobiani S. Evaluation of Impacted Maxillary Canine Position Using Panoramic Radiography and Cone Beam Computed Tomography. The Saudi Dental Journal. 2020. https://doi.org/10.1016/j.sdentj.2020.03.014.

[15] Bhuvaneshwari AJ, Singh MP. Use of panoramic radiograph as a single radiographic technique to localize impacted maxillary canine. J Cancer Sci Ther. 2010;2(6):163-5.

How to Cite this Article: Tabatabaei Jebeli ZS, Rafiei M, Torkzadeh A. Accuracy of Panoramic Radiography in Assessing the Labio-palatal Position of Maxillary Impacted Canines and Root Resorption of the Adjacent Tooth. *International Journal of Scientific Research in Dental and Medical Sciences,* 2020;2(4):121-125. doi: 10.30485/IJSRDMS.2020.254092.1093.