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Reliability of Panoramic Radiographs for Early Prediction of Impacted Maxillary Canine

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ABSTRACT

The word "early" is sometimes regarded as occurring before the usual or physiological period in the biological sense. The average age at which an upper canine must erupt is 13 years in boys, 12 years in girls and three months. Thus, the ability to detect tooth malposition as early as in the early mixed dentition (8 years approximately) and anticipate canine impaction in the same time will be highly helpful to the clinician for a positive outcome of the procedure. To predict the impaction of canine using panoramic radiographs and re-confirmed using cone-beam computed tomography. Fifty cases out of which ten had bilaterally impacted maxillary canines, and 40 had unilaterally impacted maxillary canines with an average age of 10-11years ±5 months. Firstly, tracings were performed on orthopantomogram, and sector location classification as given by Steven Lindauer was applied. Findings from orthopantomogram were compared to Cone Beam Computed Tomography findings. In the labial group, 55% canine cusp tips were in sectors I, 40% in sector II and 5% in sector III. Whereas in the palatal group, 10% were in sector II, 60% in sector III and 30% in sector IV. This research demonstrates that the sector location of impacted canine as presented by Steven Lindauer that root apices may be used to forecast maxillary canine impactions early and to determine their labiopalatal location on panoramic radiographs.

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INTRODUCTION

Canines are necessary for functional and esthetic harmony. But unfortunately, the prevalence rate of impaction of maxillary canines is 1-3%, i.e. the second-highest frequency after third molar impaction. (Bishara, 1998) It was found impaction of maxillary canine to be more common in girls than in boys. (Hitchin, 1956; Rayne, 1969) Canine impaction was found to be palatally impacted in 85 % of patients and buccally impacted in 15% cases. 8% of all the instances are forecasted to have bilateral maxillary canine impaction. (Peck *et al.*, 1996)

Disturbances in the eruption of permanent maxillary canines are found to be very common because of the most extended developmental period, the most superior developmental area and when compared to any other tooth, the canine has the most difficult path of eruption.

Majorly, two theories have been proposed to elucidate palatal impact on the occurrence of maxillary canines- the guidance theory and the genetic theory. (Peck *et al.*, 1996) The malposed canine lacks the 'guide' presented by the neighbouring teeth

roots, so the position of the tooth bud and the path fol

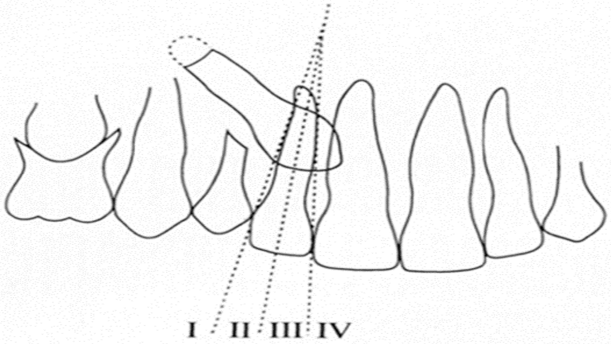


Figure 1: Sector location classification as given by Steven Lindauer

lowed for eruption predominate with local causes for the anomaly. (Becker *et al.*, 2002) Crowding can, however, play an essential role in causing canine to be palatally impacted, a buccally impacted canine is usually associated with arch length deficiency (Langberg and Peck, 2000). According to the genetic theory, canines which are displaced palatally are genetically determined abnormalities in the dental lamina arising from the developmental disruption. (Baccetti, 1998; Leonardi *et al.*, 2003)

The related dental features (including aplasia and reduced size of the lateral incisors) facilitate early clinical diagnosis of eruption condition.

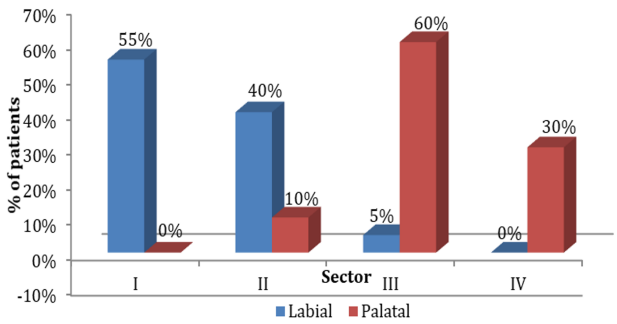
Effective diagnosis of the impacted tooth and estimation of potential eruption loss is one of the primary considerations for the assessment and monitoring of complicated tooth condition such as permanent maxillary canine impacted. (Hurme, 1949) The probability of identifying tooth malposition as early as in early mixed dentition (average age of 8 years) and of expecting canine impaction at the same time would also be of considerable assistance to the clinician for a successful outcome of the procedure. Steven Lindauer suggested a methodology in which the author intended to establish a method for the early prediction of impacted canine on orthopantomogram to develop effective prevention measures, check and use them for early prediction of maxillary canine impaction. (Lindauer *et al.*, 1992)

Hence, using the method proposed by Steven Lindauer, this study was performed to assess the reliability of the above methodology and was confirmed with the use of cone-beam computed tomography with their respective orthopantomograms. Therefore, the present study was undertaken to evaluate the early prediction of maxillary impacted canine using panoramic radiographs.

MATERIALS AND METHODS

The subjects were chosen from the outpatient department of Orthodontics and Dentofacial Orthopedics. The study consisted of 50 cases out of which ten had bilaterally impacted maxillary canines, and 40 had unilaterally impacted maxillary canines. Out of 50 cases, 28 were females, and 22 were males, with an average age of 10-11years ± five months. Inclusion criteria were patients who had orthopantomogram and CBCT both.

Exclusion criteria were a systemic illness, cleft lip palate, mesiodens & odontoma. The Institutional Ethics Committee reviewed and approved this study. (In this study, the total number of canines are taken into consideration and not the total number of patients)



Graph 1: Number of canine cusp tips located in the various sectors in the impacted canine group

To confirm the exact locations of the root apex, Cone-beam Computed Tomography was used. The Cone-beam Computed Tomographysettings followed were: tube voltage of 90 kVp; scan time of 24 seconds; tube current of 4 mA; voxel size of 0.3 mm; and field of view of 10*8 cm. Utilizing Cone-beam Computed Tomography information, each sample was classified by the affected canine crown area and explicitly by the labiopalatal relationship to yield the following groups: the labial group and the palatal group. Group labial had 20 and group palatal had 40 canines. Firstly, tracings were performed on OPG and sector location classification as given by Steven Lindauerwas applied. (Lindauer *et al.*, 1992) According to him, the cusp tips of the canines if are in sector 1 and sector 2, they are said to be labially impacted, and if they are in sector 3 and 4, they are said to be palatally impacted. (Figure 1) Accordingly, the diagnosis was obtained on OPG's and was confirmed using several CBCT images. (Figure 2)

Sector I

Includes area distal to a tangent to the distal heights of the contour of the lateral incisor crown and root.

Table 1: Number of canine cusp tips located in the various sectors in the impacted canine group

Impactions	I	II	III	IV
Labial(n=20)	11(55%)	8(40%)	1(5%)	0(0%)
Palatal(n=40)	0(0%)	4(10%)	24(60%)	12(30%)
Total(n=60)	11(18.33%)	12(20%)	25(41.67%)	12(20%)
χ2-value	26.93	7.50	16.59	7.50
p-value	0.0001,S	0.006,S	0.0001,S	0.006,S

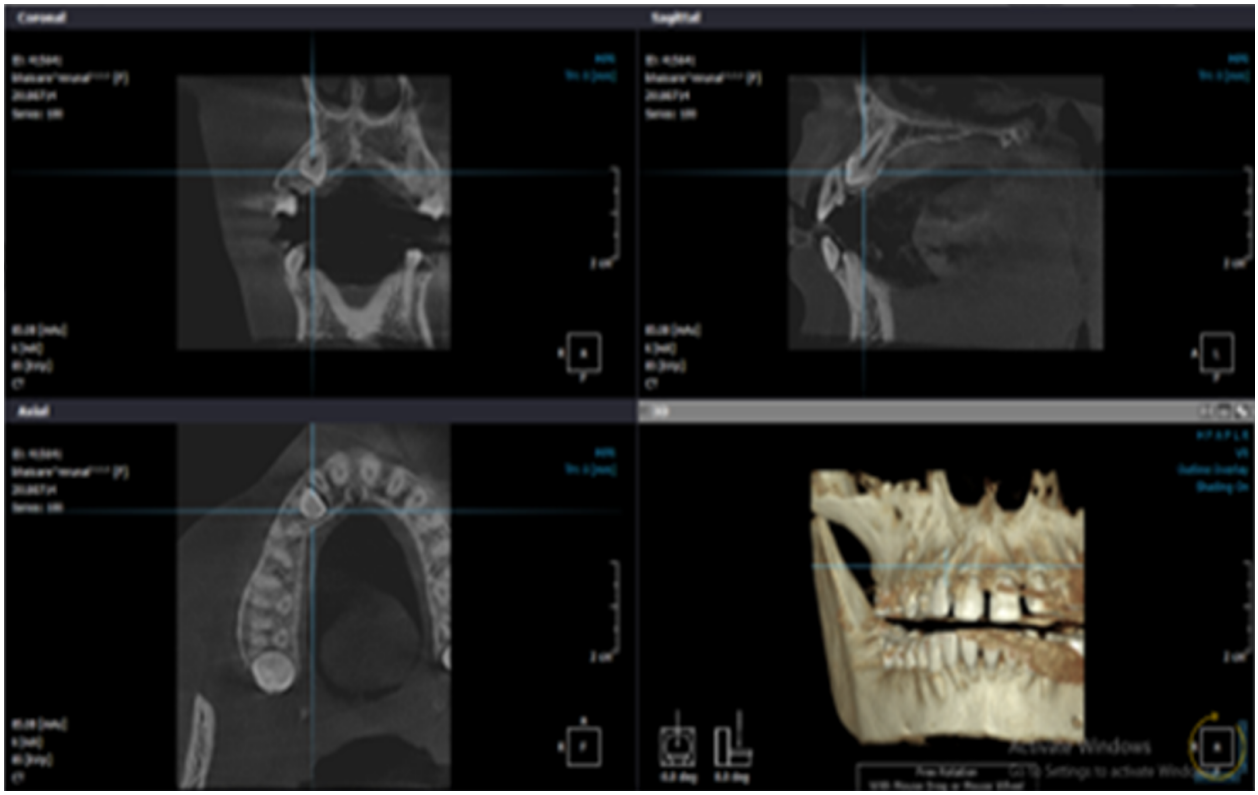


Figure 2: Cone Beam Computed Tomography image of a patient studied

Sector II

Includes mesial to the sector I, but distal to a line bisecting the mesiodistal dimension of the lateral incisor along the long axis of the tooth.

Sector III

Includes mesial to sector II, but distal to a line tangent to the mesial heights of the contour of the lateral incisor crown and root.

Sector IV

Includes all areas mesial to sector III.

Statistical Analysis

Single investigator performed each measurement. To determine the effectiveness of intra-examiners, information was re-acquired over one month. Use the Cohen kappa measurement, and an intra-examiner agreement was measured. The association between the sector location on the panoramic x-rays and the labiopalatal position on Cone Beam's computed tomography images was tested using the chi-square scale. Statistical analysis was carried out using concise and inferential statistics using chi-square test and research program version SPSS 22.0 and GraphPad Prism 6.0 and $p<0.05$ was considered as the level of significance.

RESULTS

The examiners noted that in labial group n=20, 55% canine cusp tips were in sectors I, 40% in sector II and 5% in sector III. Whereas in palatal group i.e. n=40, 10% were in sector II, 60% in sector III and 30% in sector IV. (Graph 1) By using chi square test, statistically significant difference was found in sector I between labial and palatal (χ2-value=26.93,p=0.0001), in sector II (χ2value=7.50,p=0.006), in sector III ((χ2-value=16.59,p=0.0001) and in sector IV(χ2-

value=7.50,p=0.006). Reliability of the test is 0.96. (Table 1)

DISCUSSION

Crowding of teeth may pose canine labial impaction, but it does not affect palatal impaction (Jacoby, 1983). The cause of palatal impaction remains unknown, but some authors have observed the theory of lateral incisor guidance and genetic theory (Peck *et al.*, 2002). Thus, prevention of impaction through the developmental stage may be complicated. Root resorption of proximal teeth, cyst development & associated inflammation, can be avoided by careful examination and by taking preventive action.

Therefore, various studies attempted to evaluate the new canine impactions through panoramic radiographs (Ericson and Kurol, 1986; Sajnani and King, 2012). It has been observed that there are numerous factors responsible for causing tooth disturbances which include reduced width of the maxillary lateral incisors, hypoplasia of enamel, premolar aplasia or sometimes primary molar under eruption.

The panoramic film is widely used for the assessment of diagnostic purpose in interceptive treatment planning. But it has certain limitations like frontal distortion of the dentoalveolar regions and also it is a 2D image of a 3D structure. Through early diagnosis as "risk signs" for canine impaction, the proposed approach could be supplemented favourably for the early detection of subjects vulnerable to canine impaction based on radiographic criteria.

The cusp tip positions of maxillary canines that were impacted were evaluated on panoramic radiographs through their positions labiopalatally. Then to re-confirm the position of the affected teeth, Cone Beam Computed Tomography analysis was done. Cone Beam Computed Tomography helps in the easy and proper diagnosis of the impacted teeth. It has certain limitations like high radiation dose and high cost. Thus, Orthopantomogram may facilitate the prediction of impacted canines and proper treatment planning at an early stage.

In the present study, 50 impacted canines were assessed using orthopantomogram, and the position of impacted canine was confirmed using Cone Beam Computed Tomography. In cases with labially impacted canine, majority of the cusp tips of the canine were found to be in the sector I & II (55% & 40% respectively) & few in sector III (5%). No labially impacted canine cusp tip as confirmed using Cone Beam Computed Tomography was found in sector IV. This exhibits that more the canine is medially located, less likely it is to be labially impacted. In palatally impacted canine, the majority of canine cusp tips were found in sector III, and IV (60% & 30% respectively) and few(10%) were found in sector II. No palatally impacted canine as confirmed on Cone Beam Computed Tomography image was found the sector I on Orthopantomogram.

In a similar study, (Warford *et al.*, 2003) the angulations and sector location of unerupted canines was evaluated by use of panoramic radiographs. The authors reported and suggested that sector location classification is a better predictor in cases of the impacted canine.

Another study (Lindauer *et al.*, 1992; Jung *et al.*, 2012) found that the cuspal tips of canines that are palatally impacted overlapped with the lateral incisor or were mesial to it. Such findings of the research are in alignment with our study in which the palatally impacted canines root apices converge towards the first maxillary premolars root apices, and the crown tips of canines can be mesial to the lateral incisors. In research (Warford *et al.*, 2003) they found that the impaction was determined more strongly by the sector location than by angulation.

These observations are useful for early diagnosis of maxillary canine impaction & for the labiopalatal locations of canines impacted by panoramic radiographs. For instance –the canine root apex of a child is guided facing the root apex of the first premolar assessed through the use of panoramic films. Palatal impaction of the canine may be indicated. In case, the canine root apex of a younger child is oriented toward the lateral incisor then canine may indicate labial impaction. Subsequent visits will be recommended in all cases.

The critical drawback of this research is the sample size was small. Evidence and confirmation of our findings would take more comprehensive studies. A second disadvantage was the lack of a system of classifying the raw sector classification method. A more detailed approach should be considered. Third, techniques should also be explored, which combines both the tips of the crown and the root apices of impacted canines in panoramic films. Finally, situations involving unerupted canines with subsequent impaction history and exposure to panoramic films should be examined for other purposes as well.

CONCLUSIONS

In sector 2 & 1 (corresponding to the lateral incisor), labially impacted canines were more fre-

quent, whereas, in sector 3 & 4 (corresponding to the first premolar), palatially impacted canines were more common. In other terms, the root spices of palatally impacted canines pointed toward the root apex of the maxillary first premolar. In contrast, those of labially impacted canines leaned toward the root apex of the lateral maxillary incisor on panoramic films. This research indicates that root apices may be used to forecast maxillary canine impactions early and to determine their labiopalatal location as suggested by Steven Lindauer's classification of sector location.

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Conflict of Interest

The authors have no conflict of interest for this study.

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REFERENCES

Baccetti, T. 1998. A clinical and statistical study of etiologic aspects related to associated tooth anomalies in number, size, and position. . *Minerva stomatological*, 47:655–663.

Becker, A., Sharabi, S., Chaushu, S. 2002. Maxillary tooth size variation in dentitions with palatal canine displacement. *The European Journal of Orthodontics*, 24(3):313–318.

Bishara, S. E. 1998. Clinical management of impactedmaxillary canines. *Seminars in Orthodontics*, 4(2):87–98.

Ericson, S., Kurol, J. 1986. Longitudinal study and analysis of clinical supervision of maxillary canine eruption. *Community Dentistry and Oral Epidemiology*, 14(3):172–176.

Hitchin, A. D. 1956. The impacted maxillary canine. *Br Dent J*, 100:1–14.

Hurme, V. O. 1949. Ranges of normalcy in the eruption of permanent teeth. *Journal of dentistry for children*, 16(2):11–15.

Jacoby, H. 1983. The aetiology of maxillary canine impactions. *American journal of orthodontics*, 84(2):125–132.

Jung, Y. H., Liang, H., Benson, B. W., Flint, D. J., Cho, B. H. 2012. The assessment of impacted maxillary canine position with panoramic radiography and cone beam CT. *Dentomaxillofacial Radiology*, 41(5):356–360.

Langberg, B. J., Peck, S. 2000. Adequacy of maxillary dental arch width in patients with palatally displaced canines. *American Journal of Orthodontics and Dentofacial Orthopedics*, 118(2):220–223.

Leonardi, R., Peck, S., Caltabiano, M., Barbato, E. 2003. Palatally displaced canine anomaly in monozygotic twins. *The Angle Orthodontist*, 73(4):466–470.

Lindauer, S. J., Rubenstein, L. K., Hang, W. M., Andersen, W. C., Isaacson, R. J. 1992. Canine Impaction Identified Early with Panoramic Radiographs. *The Journal of the American Dental Association*, 123(3):91–97.

Peck, S., Peck, L., Kataja, M. 1996. Site-specificity of tooth agenesis in subjects with maxillary canine malpositions. *The Angle Orthodontist*, 66(6):473–476.

Peck, S., Peck, L., Kataja, M. 2002. Concomitant occurrence of canine malposition and tooth agenesis: Evidence of orofacial genetic fields. *American Journal of Orthodontics and Dentofacial Orthopedics*, 122(6):657–660.

Rayne, J. 1969. The unerupted maxillary canine. . *The Dental practitioner and dental record*, 19:194–204.

Sajnani, A. K., King, N. M. 2012. Early prediction of maxillary canine impaction from panoramic radiographs. *American Journal of Orthodontics and Dentofacial Orthopedics*, 142(1):45–51.

Warford, J. H., Grandhi, R. K., Tira, D. E. 2003. Prediction of maxillary canine impaction using sectors and angular measurement. *American Journal of Orthodontics and Dentofacial Orthopedics*, 124(6):651–655.