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Original Research Article

LOCALISATION OF IMPACTED MAXILLARY CANINES USING PANORAMIC RADIOGRAPHS; A NOVEL TECHNIQUE THAT USES BICONDYLAR LINE AS REFERENCE

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Abstract:

Purpose: To localize the impacted maxillary canines in the alveolus using panoramic radiographs.

Methods: The present study was a retrospective radiographic chart review of 81 patients with 92 impacted maxillary canines from the Department of oral and maxillofacial surgery, PMS College of Dental Science and Research, Trivandrum. Of the 92 impacted maxillary canines, 57 were impacted buccally and 35 were impacted palatally. The ratio formed between the distance from the crown tips of impacted maxillary canine and ipsilateral central incisors were measured. We used these measurements to predict the position of the tooth and correlate this prediction with the actual approach used during surgery.

Results: The ratio of the canines in the buccal group was 1.35± 0.144(range, 1.04 to 1.88). Palatal group has got little higher values with the mean ratio of 1.93± 0.52 (range, 1.29 to 3.22). The ratios were distributed over a scatter plot (Figure 2). The diagnostic test characteristics for the values greater than 1.45, greater than 1.50 and greater than 1.55 were taken. These values were used for constructing a receiver operating curve. There was a better sensitivity and specificity for the values greater than 1.50(sensitivity: 94.29%, specificity: 91.38%). Logistic regression showed that if the ratio is more than 1.50, there is a chance of 19.3 times to get a canine palatally impacted.

Conclusion: There is significant difference in the vertical position of buccal and palatal canines in the alveolus. Based on our values we found that palatally impacted canines are restricted more superiorly.

Keywords: Localization, impacted maxillary canines, panoramic radiographs, bicondylar line

Introduction

The incidence of the impacted maxillary canines varies according to the population. It occurs in 0.92% to 2.2%in populations and stands second after lower third molars. Palatal canines are more common (85%) than buccal canines and bilateral canines account for 8%¹. The impacted maxillary canines could be either located palatally, buccally or in the midway of the alveolus. Even though three dimensional radiographs such as CT and CBCT could be considered as the gold

standard for the localization the reliability of two dimensional localization techniques using panoramic radiographs are still accepted. There are many principles of localization used in two dimensional techniques, among which principle of magnification is preferred as more accurate². Chausu et al ³ found that there is difference in relative magnification for palatal and buccal canines on panoramic radiographs. As palatal canines are being located more close to the source of radiation, it gets more magnified. In the same study they included the concept of vertical

restriction which states that the palatal canines are more superiorly placed on the maxillary alveolus. In this study we have quantified the amount of vertical restriction by finding out the ratio formed between the distance from the ipsilateral central incisor and the impacted maxillary canines to the bicondylar line.

MATERIALS AND METHODS

The study was a retrospective radiographic chart review. All the subjects included in the study sample were derived from the patients treated in the Department of oral and maxillofacial surgery, PMS College of Dental Science and Research, Trivandrum. We included all the subjects who had undergone surgical removal or surgical exposure of impacted maxillary canines from 2013 to 2017. Patients' age and gender were considered as study variables. After collecting the digital formats of the panoramic radiographs, a third party vector graphics software was used for constructing the following lines. A horizontal reference line connecting the highest point of the two condylar heads was constructed on the panoramic radiograph which was considered as the 'bicondylar' line. Two vertical lines were drawn from the bicondylar line. The first vertical line (a) was drawn downwards from the bicondylar line to the crown tip of the impacted maxillary canine. The second vertical line (b) was drawn down from the bicondylar line to the most prominent point on the incisal edge of the ipsilateral central incisor. The measurements of the two lines (a and b) were measured and the ratio b/c was calculated Fig.1a and 1b. The primary outcome variable was the location of the impacted canine, which could be nearer to the buccal cortex for buccally impacted canines or palatal cortex for palatally impacted canines. Data collected were entered in a spreadsheet during the study and was analyzed using a commercially available statistics

analyzing package (Medcalc version 17.9, MedCalc Software bvba). By computing the descriptive statistics we established the distribution of the ratios for buccally and palatally impacted canines. The mean ratios for both groups were compared using nonparametric methods. For finding out the threshold for diagnostic tests related to the buccaly impacted canines, the values were distributed over a scatter plot. For each thresholds, sensitivity, specificity, negative and positive predictive values were computed. A receiver operating characteristic curve was constructed to compare the various thresholds. Logistic regression analysis was also done. After all analysis, a *P* value less than .05 was considered statistically significant.

RESULTS

During the period of four years, panoramic radiographs of 81 patients were evaluated. Out of 81 subjects, 58 were females and 23 were males Table 1. In 37 patients, canines were bilaterally impacted. Thus a total of 92 canines were studied. Right sided canines were 47 in number and 45 canines were on the left side. Of the 92 canines, 57 were in the buccal group and 35 were in the palatal group. The ratio of the canines in the buccal group was 1.35± 0.144(range, 1.04 to 1.88). Palatal group has got little higher values with the mean ratio of 1.93± 0.52 (range, 1.29 to 3.22). The ratios were distributed over a scatter plot fig.2. The diagnostic test characteristics for the values greater than 1.45, greater than 1.50 and greater than 1.55 were taken. These values were used for constructing a receiver operating curve. There was a better sensitivity and specificity for the 1.50(sensitivity: 94.29%, values greater than specificity: 91.38%) fig.3. Logistic regression showed that if the ratio is more than 1.50, there is a chance of 19.3 times to get a canine palatally impacted.

Table 1: Descriptive statistics of the subjects

Frequency of ratio of the vertical restriction	Buccal group (n =57)	Palatal group (n=35)
< 1.1	1 (1.75%)	0 (0.0%)
1.11 – 1.3	18 (31.5%)	1 (2.85%)
1.31 – 1.5	33 (57.8%)	1 (2.85%)
1.51 – 1.7	3 (5.2%)	11 (31.4%)
1.71 - 1.9	2 (3.75%)	14 (40.2%)
1.91 – 2.1	0 (0.0%)	1 (2.85%)
2.11 - 2.3	0 (0.0%)	0 (0.0%)

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2.31 – 2.5	0 (0.0%)	0 (0.0%)
2.51 – 2.7	0 (0.0%)	1 (2.85%)
2.71- 2.9	0 (0.0%)	3 (8.5%)
2.91 – 3.1	0 (0.0%)	0 (0.0%)
3.11 – 3.3	0 (0.0%)	3 (8.5%)
Mean ± SD Range	1.35± 0.144	1.93 ± 0.52
	1.04 to 1.88	1.29 to 3.22
p < 0.01		

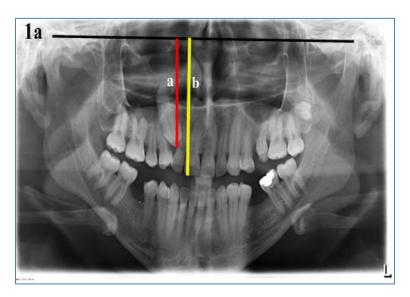


Figure 1a: analysis of panoramic radiographs of with buccally impacted canines. Black line represents the bicondylar line. Red line (a) represents the distance between the bicondylar line and the crown tip of the impacted canine. Yellow line (b) represents the distance between the bicondylar line and crown tip of the ipsilateral central incisor.

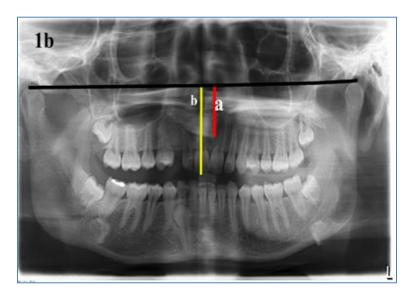


Figure 1b: analysis of panoramic radiographs of with palatally impacted canines

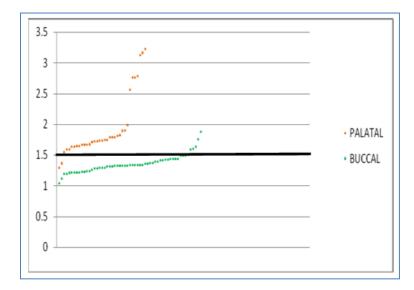


Figure 2: scatter plot diagram showing significant variance in distribution of ratios associated with buccally impacted teeth versus palatally impacted teeth.

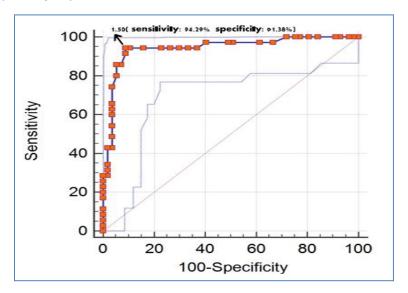


Figure 3: Receiver operating characteristic curve demonstrating that diagnostic test threshold resulting in best combination of sensitivity and specificity is 1.50

DISCUSSION

Chausu et al proposed a concept called vertical restriction of impacted maxillary canines. On a panoramic radiograph having impacted maxillary canine, the root of the ipsilateral lateral incisor was divided into three equal zones named apical zone, middle zone and coronal zone. They found that the palatal canines were more located on the apical zones. This concept of vertical restriction was included in the present study. In fact we tried to quantify the vertical restriction of impacted canines in the maxillary alveolus by creating a ratio. By using the receiver operating curve we found that the best

cut off value for palatal canines was 1.50. Any values greater than 1.50 has got 19.3 times chance of the canine being palatally impacted. The concept of using the bicondylar line as reference is not new. Warford et al⁴ have used bicondylar line as reference to predict the future of erupting canines. They found that the angle formed between the long axis of the erupting maxillary canine and the bicondylar line was higher for non-impacted teeth (with a mean of 75.12°). Katsnelson et al⁵ found that the angle formed between the impacted maxillary canine and the occlusal plane is greater than 65° for buccaly placed canines. This also showed that the palatally

impacted canines were less angulated and more superiorly placed when compared to buccal canines. The diagnostic test characteristics used by Katsnelson et al⁵ for their study was more statistically acceptable. We also found that receiver operating curve gave us more dependable cut off value for the ratio. Our study has got significant strength and weakness. With a reasonable sample size, we found quantify the concept of vertical restriction by using adequate data for analysis.

Ideal method for comparison would be with any three dimensional radiographs⁵ but it would not be feasible for all subjects. The approach to an impacted canine in the midway of the alveolus could be from both sides. For such cases, measuring the depth of the bone removed could also be included for better standardization. In the future, it is sure that the three dimensional localization techniques will dominate the conventional ones as they are becoming popular. Till then the panoramic radiographs will remain as a reliable technique for the treatment of impacted maxillary canines.

CONCLUSION

There is significant difference in the vertical position of buccal and palatal canines in the alveolus. Based on our values we found that palatally impacted canines are restricted more superiorly.

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