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RESEARCH ARTICLE

COMPARATIVE EVALUATION OF VERTICAL PARALLAX AND MAXILLARY TRUE OCCLUSAL RADIOGRAPHS FOR THE LOCALIZATION OF IMPACTED MAXILLARY CANINES

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ABSTRACT

Introduction: Impacted maxillary canines are the second most frequently impacted teeth after the third molar. This is most likely due to an extended development period and the long, tortuous path of eruption. Precise localization of impacted maxillary canines has been a challenging task for orthodontists, radiologists as well as oral surgeons.

Objectives: The objectives of the study were to compare the accuracy of vertical tube shift technique and true maxillary occlusal view in the localization of impacted maxillary canines and to confirm the location of the impacted maxillary canine by surgical intervention.

Materials and Methods: The study included prospective clinical and radiographic analysis followed by appropriate surgical intervention of 20 impacted maxillary canines in 18 patients. The Radiographic Examination included: Vertical tube shift technique – using two intraoral periapical radiographs and Maxillary true /vertex occlusal view.

Results: According to kappa analysis, true maxillary occlusal view was more accurate for determining position of cusp tip of canine (91.6%), position of root apex of canine (87.5), relationship of the canine cusp tip and root of adjacent incisor (59.3%), Curvature of root (76.9%). Paired t-test for comparison of length of the crown of canine (cusp tip to CEJ) revealed – 1.027 differences in mean values of True maxillary occlusal view and surgical intervention. Distance of canine cusp tip from the mesioincisal edge of adjacent tooth paired t-test for this comparison revealed -0.094 differences in mean values of True maxillary occlusal view and surgical intervention;

Conclusion: The true maxillary occlusal view was superior to vertical tube shift technique in 6 out of 8 parameters studied, although in 2 of the parameters i.e. length of the crown of the canine and curvature / dilacerations of the root apex, Vertical tube shift technique provided better results.

INTRODUCTION

Impacted maxillary canines are the second most frequently impacted teeth after the third molar. This is most likely due to an extended development period and the long, tortuous path of eruption.

Precise localization of impacted maxillary canines has been a challenging task for orthodontists, radiologists as well as oral surgeons. Accurate radiographs are critical for determining the position of impacted maxillary canines, their relationship to adjacent teeth, assessing the health of the neighbouring roots and determining the prognosis and best mode of treatment. Various conventional radiographs have been used either alone or in conjunction to accurately determine the position of the impacted maxillary canine viz. IOPA radiographs, Orthopantomograms (OPG), Lateral cephalograms, vertical and horizontal parallax (tube shift technique), maxillary topographic occlusal view, maxillary vertex / true occlusal view.

Although Computed tomography (CT) is more accurate in terms of locating the impacted cuspid in 3 dimensions and for diagnosing associated lesions such as root resorption of adjacent teeth; its routine use for the management of impacted cuspids is controversial.

Objectives

The objectives of the study were

- To compare the accuracy of vertical tube shift technique and true maxillary occlusal view in the localization of impacted maxillary canines.
- To confirm the location of the impacted maxillary canine by surgical intervention.

To achieve the objectives of the study eight parameters were considered during the study:

1	Position of cusp tip of canine in the arch (Buccal / Palatal
2	Position of root apex of canine (On the arch / Buccal / Palatal)
3	Relationship of the canine cusp tip and root of adjacent incisor
4	Mesiodistal width of the crown of canine
5	Length of the crown of canine (cusp tip to CEJ)
6	Distance of crown tip of canine from mesioincisal edge of adjacent incisor
7	Curvature of root (dilaceration)
8	Resorption of root of lateral incisor

MATERIALS AND METHODS

The study was conducted in the Department of Oral and Maxillofacial Surgery, Bharati Vidyapeeth University, Dental College and Hospital, Pune. The study included prospective clinical and radiographic analysis followed by appropriate surgical intervention of 20 impacted maxillary canines in 18 patients.

Criteria for patient selection

1. All patients with unilateral or bilateral impacted maxillary canines requiring surgical removal or surgical exposure for orthodontic repositioning in the arch.
2. Patient's age group: above 11 years.

Exclusion criteria

1. Patients with maxillary canine visible in the oral cavity on clinical examination
2. Medically compromised patients or patients with other debilitating disease

METHODS

All patients underwent a routine clinical as well as a radiographic examination, to determine a specific treatment plan for the impacted maxillary canine – surgical exposure for orthodontic repositioning or surgical removal of the tooth. Informed written consent was taken from every patient after explaining the procedure. Detailed history and necessary investigations were performed before commencing the planned surgical intervention.

The Radiographic Examination included:

- Vertical tube shift technique – using two intraoral periapical radiographs
- Maxillary true / vertex occlusal view

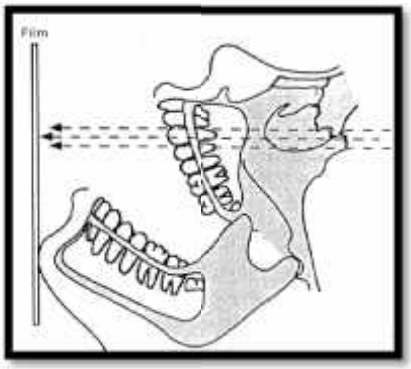
Vertical tube shift technique

The procedure was carried out on a chair-side dental x-ray machine {Tube Voltage - 65-75 kVp, Tube Current - 8-10 mAmp, and Exposure Time – 0.8 seconds} using Intra-oral Periapical (IOPA) films and an Image receptor holder (IRH)

METHODOLOGY

The patient was seated in the dental chair in upright position. The film was placed in the image receptor holder (IRH) and placed in the region of the impacted maxillary canine. The central beam of the x-ray was directed perpendicular to the IOPA film using the standard angulation for *bisecting angle projections* of maxillary canines (+45 degrees) at 0.9 kVp. The radiographs were made in such a way that the relationship of the crown of the impacted canine to the roots of the existing dentition were completely depicted. The second film was placed in the same region and the vertical angulation of the central beam of the x-ray was raised superiorly by 20 degrees. The IRH with the IOPA film was angulated such that the central beam of the x-ray remains perpendicular to the film. Both the radiographs are processed and then evaluated using the "SLOB rule" (Same Lingual Opposite Buccal).

Maxillary True / Vertex Occlusal radiograph We utilized an extra-oral technique for imaging the maxillary dentition in the superoinferior aspect. The radiograph obtained is very similar to the conventional vertex/true occlusal radiograph.



The maxillary true occlusal radiograph was made using a General body x-ray machine or cephalometric x-ray setup with 12 x 9 cm Lateral cephalogram film or green sensitive double emulsion film along with an Extra-oral Film cassette with rare earth intensifying screens

Technique

The patient was seated facing the extra-oral cassette. The patient was instructed to press the chest against the table with the neck fully extended. Most of our patients were young and had no difficulty with cervical hyperextension. The patients were instructed to open the mouth as wide as possible. The head was adjusted so that the upper occlusal plane is parallel to the film with the chin resting on the table. The patients were asked to hold on to the erect tray holding the film cassette to further stabilize the position and thus reduce head movement. The film cassette was positioned centrally in front of the maxilla in the tray. The x-ray tube was directed so that the central ray was perpendicular to the upper occlusal plane and passes through and parallel to the level of the maxillary canines. The x-ray tube was angled to compensate for limitation in cervical extension in some cases. The x-ray beam

is collimated to include the whole of the maxillary dentition. The radiograph was taken on suspended respiration.

Standardization

Machine type: Conventional General radiography unit or Kodak CR 7400 Digital radiography system	
Focus – skin distance :70 cms	Focus- film distance:100 cms
Tube Voltage : 78 kVp	Tube current : 12 mA for conventional film and 15 mAs for Digital radiography system
Exposure time :	12 seconds for conventional film and 3.20 seconds for Digital radiography system

Surgical Intervention (SI)

All the patients underwent surgical intervention:

1. Removal of the impacted maxillary canine
2. Exposure of impacted maxillary canine for orthodontic repositioning

RESULTS

The record of 20 impacted maxillary canines of 18 patients (9 male and 9 female) were accounted for in this study. Of these patients, two patients had bilaterally impacted canines. Vertical tube shift (VTS) using two Intra-oral periapical films and

1. True maxillary occlusal view (TMO)– using extra-oral film.

The "gold standard" used for comparison of these 2 sets of radiographs was taken as the position of canine at the time of surgical intervention. 20 cases of impacted maxillary canine were selected for the analysis, and various parameters were assessed using the following analysis:

Table 1 VTS-position cusp tip of canine versus **SI**-position cusp tip of canine

		SI-position cusp tip			Total
		BUCCAL	ON THE ARCH	PALATAL	
VTS-position cusp tip	BUCCAL	3	2	0	5
	ON THE ARCH	0	3	0	3
	PALATAL	0	1	11	12
Total		3	6	11	20

Symmetric Measures

		Value	Percentage	'p' value
Measure of Agreement	Kappa	.745	74.5 %	.000
N of Valid Cases		20		Statistically significant

Table 1: Comparison of Position of cusp tip of impacted canine on Vertical tube shift and surgical intervention – Kappa analysis. This comparison reveals **74.5%** agreement between Vertical tube shift technique and surgical intervention.

Table 2 TMO-position cusp tip of canine versus**SI**-position cusp tip of canine

		SI-position cusp tip of canine			Total
		BUCCAL	ON THE ARCH	PALATAL	
TMO-position cusp tip	BUCCAL	3	0	0	3
	ON THE ARCH	0	6	1	7
	PALATAL	0	0	10	10
Total		3	6	11	20

Symmetric Measures

		Value	Percentage	'p' value
Measure of Agreement	Kappa	.916	91.6 %	.000
N of Valid Cases		20		

Table 2: Comparison of Position of cusp tip of impacted canine on True maxillary occlusal view and surgical intervention – Kappa analysis. This comparison reveals **91.6%** agreement between True maxillary occlusal view and surgical intervention; thus proving it to be ***more*** accurate & closer to results of surgical intervention than vertical tube shift technique **(74.5%).**

Table 3 VTS - position of root apex of canine * SI - position of root apex of canine

		SI - position root apex		Total
		On The Arch	Palatal	
VTS - position root apex	On The Arch	1	0	1
	Palatal	5	14	19
Total		6	14	20

Symmetric Measures

		Value	Percentage	'p' value
Measure of Agreement	Kappa	.219	21.9%	.117
N of Valid Cases		20		statistically **not** significant

Table 3:Comparison of Position of root apex of impacted canine on Vertical tube shift and surgical intervention – Kappa analysis. This comparison reveals **21.9%**agreement between Vertical tube shift technique and surgical intervention.

Table 4:Comparison of Position of root apex of impacted canine on True maxillary occlusal view and surgical intervention – Kappa analysis. This comparison reveals **87.5%**agreement between True maxillary occlusal view and surgical intervention; thus proving it to be ***more*** accurate & closer to results of surgical intervention than vertical tube shift technique (**21.9%**)

Table 5:Comparison of curvature of rootof impacted canine on Vertical tube shift technique and surgical intervention – Kappa analysis.

This comparison reveals **85.2%**agreement between Vertical tube shift technique and surgical intervention

Comparison of curvature of rootof impacted canine on True maxillary occlusal view and surgical intervention – Kappa analysis. This comparison reveals **76.9%** agreement between True maxillary occlusal view and surgical intervention; thus proving it to be ***less*** accurate to results of surgical intervention than vertical tube shift technique (**85.2%**)

Comparison of relation of canine cusp tip and root of adjacent incisor of impacted canine on Vertical tube shift technique and surgical intervention – Kappa analysis. This comparison reveals **21.2%** agreement between Vertical tube shift technique and surgical intervention.

Comparison of relation of canine cusp tip & root of adjacent incisoron True maxillary occlusal view and surgical intervention – Kappa analysis. This comparison reveals **59.3%**

agreement between True maxillary occlusal view and surgical intervention; thus proving it to be ***more*** accurate & closer to results of surgical intervention than vertical tube shift technique (**21.2%**).

Table 4 TMO - position of root apex of canine * SI - position of root apex of canine

TMO-position root apex	SI-position root apex		Total
	On the arch	Palatal	
On the arch	5	0	5
Palatal	1	14	15
Total	6	14	20

Symmetric Measures

		Value	Percentage	'p' value
Measure of Agreement	Kappa	.875	87.5 %	.000
N of Valid Cases		20		

Table 5 VTS - curvature of root of canine * SI - curvature of root of canine

VTS-curvature of root		SI-curvature of root		Total
		NO	YES	
	NO	13	1	14
	YES	0	4	4
Total		13	5	18
Kappa		0.852459		85.2 %

Table 6 TMO - curvature of root of canine * SI - curvature of root of canine

		SI-curvature of root		Total
		NO	YES	
TMO-curvature of root	NO	15	1	16
	YES	0	2	2
Total		15	3	18
kappa		0.769231	76.9 %	

Table 7 VTS - relation of canine cusp tip & root of adjacent incisor* SI - relation of canine cusp tip & root of adjacent incisor

VTS-relation of canine cusp tip and root of adjacent incisor	SI-relation of canine cusp tip and root of adjacent incisor					Total
	Absent	Crossing	Overlapping	Placed palatally	Touching	
Absent	3	0	0	0	0	3
Crossing	0	1	0	3	3	7
Overlapping	0	0	0	0	4	4
Placed palatally	0	0	0	1	1	2
Touching	0	0	1	1	2	4
Total	3	1	1	5	10	20

Symmetric Measures

		Value	Percentage	'p' value
Measure of Agreement	Kappa	.212	21.2 %	.019
N of Valid Cases		20		

Table 8 TMO - relation of canine cusp tip & root of adjacent incisor* SI - relation of canine cusp tip & root of adjacent incisor

TMO-relation of canine	SI-relation of canine					Total
	Absent	Crossing	Overlapping	Placed palatally	Touching	
Absent	3	0	0	0	0	3
Crossing	0	1	0	1	1	3
Overlapping	0	0	1	0	2	3
Placed palatally	0	0	0	3	1	4
Touching	0	0	0	1	6	7
Total	3	1	1	5	10	20

Symmetric Measures

		Value	Percentage	'p' value
Measure of Agreement	Kappa	.593	59.3 %	.000
N of Valid Cases		20		

Table 9 VTS - mesio-distal width of crown of canine * SI - mesio-distal width of crown of canine TMO - mesio-distal width of crown of canine

Paired t-test Statistics

		Mean	Difference in mean value	Std. Deviation	'p' value
Pair 1	VTS-mesio-distal width	9.350	0.8	1.2886	≈ 0.05
	SI-mesio-distal width	8.550		1.1110	
Pair 2	TMO-mesio-distal width	9.050	0.5	1.2020	≈ 0.05
	SI-mesio-distal width	8.550		1.1110	

Comparison of mesio-distal width of crown of canine on vertical tube shift technique and surgical intervention – Paired t-test. This comparison reveals **0.8** differences in mean values of vertical tube shift technique and surgical intervention.

Comparison of mesio-distal width of crown of canine on True maxillary occlusal view and surgical intervention – Paired t-test. This comparison reveals **0.5** differences in mean values of True maxillary occlusal view and surgical intervention; thus proving to be ***more*** accurate & closer to results of surgical intervention than vertical tube shift technique (**0.8**). The 'p' value for both the observations was though borderline. So, results were borderline statistically significant.

Table 10VTS - length of crown of canine * SI - length of crown of canine TMO - length of crown of canine

Paired t-test Statistics

		Mean	Difference in mean value	Std. Deviation	'p' value
Pair 3	VTS-length of crown	11.132	- 0.079	1.5442	.875
	SI-length of crown	11.211		1.5304	
Pair 4	TMO-length of crown	10.167	- 1.027	1.8708	.014
	SI-length of crown	11.194		1.5731	

Comparison of length of crown of canine on vertical tube shift technique and surgical intervention – Paired t-test. This comparison reveals - **0.079**differences in mean values of vertical tube shift technique and surgical intervention. The 'p' value for this observation set was **not statistically significant**. Comparison of length of crown of canine on True maxillary occlusal view and surgical intervention – Paired t-test. This comparison reveals **– 1.027** differences in mean values of True maxillary occlusal view and surgical intervention; thus proving it to be ***less*** accurate than vertical tube shift technique (**- 0.079**). The 'p' value for this observation set was **statistically significant**. So, length of the crown was better assessed with the vertical tube shift technique. The negative values of the mean proves that there is a degree of magnification on both the radiographs but is relatively less in case of vertical tube shift technique due to proximity of the source to the film.

Table 11VTS - Distance of crown tip of canine from mesioincisal edge of adjacent incisor*

SI - Distance of crown tip of canine from mesioincisal edge of central incisor

TMO - Distance of crown tip of canine from mesioincisal edge of central incisor *

SI - Distance of crown tip of canine from mesioincisal edge of central incisor

Paired t-test Statistics

		Mean	Difference in mean value	Std. Deviation	'p' value
Pair 5	VTS-dist of crown	14.938	5.219	5.4095	.007
	SI-dist of crown	9.719		5.5856	
Pair 6	TMO-dist of crown	9.625	- 0.094	6.4743	.767
	SI-dist of crown	9.719		5.5856	

Comparison of Distance of crown tip of canine from mesioincisal edge of adjacent incisoron vertical tube shift technique and surgical intervention – Paired t-test. This comparison reveals **– 5.219**differences in mean values of vertical tube shift technique and surgical intervention. The 'p' value for this observation set was **statistically significant**.

Comparison of Distance of crown tip of canine from mesioincisal edge of adjacent incisoron True maxillary occlusal view and surgical intervention – Paired t-test. This comparison reveals **---0.094** differences in mean values of True maxillary occlusal view and surgical intervention; thus proving it to be ***less*** accurate & closer to results of surgical intervention than vertical tube shift technique (**5.219**). The 'p' value for this observation set was **not statistically significant**. So, Distance of crown tip of canine from mesioincisal edge of adjacent incisor was better assessed with the True maxillary occlusal view.

DISCUSSION

Exact localization of impacted teeth is important before any surgical treatment is initiated. This particularly holds true for impacted maxillary canine teeth, which often present with diverse radiographic positions in different radiographic views, adding to its positional ambiguity.

In **1986, *J.J. Keur***proposed radiographic localization techniques to determine the relative position of pathologic lesions in the horizontal plane. He compared the magnification method, vertex or true occlusal method and parallax or tube shift method and commented on their accuracy and radiation safety. He concluded that vertex occlusal views produced accurate results but were questionable from radiation point of view. He observed that radiation dose was significantly reduced when using intensifying screens instead of intra-oral cassettes leading to reduced radiation exposure to head and neck. He concluded that when accurate determination of distance between the impacted teeth and the dental arch is not of paramount importance, for radiation safety reasons, localization should be performed using the tube shift technique.

Stanley G. Jacobs in **2000** worked on localization of unerupted teeth radiographically comparing the vertical tube shift method and other conventional localization techniques. He preferred the parallax method as the technique of choice to localize unerupted teeth anterior to the molars in both jaws. A vertical tube shift using a panoramic radiograph and an occlusal radiograph taken at 70° to 75° was the favored combination of radiographs using the buccal object rule. He pointed out several limitations of vertex occlusal radiographs. They may not show structures that are markedly less radiopaque than the reference teeth, may present difficulties in positioning the x-ray tube precisely, and does not show the fine detail of the unerupted object or of the roots of surrounding teeth and the alveolar bone. Thus, mandating the need for more radiographs, resulting in increased radiation exposure and expense for the patient.

To add to the list, in **2001**, ***Carol Mason et al*** compared two different radiographic techniques for localization of impacted maxillary canine: vertical parallax (from a panoramic and a maxillary anterior occlusal radiograph) and magnification (from a single panoramic radiograph). The 'gold standard' used for the radiographic comparison was the true position of canine as recorded at operation. The concluded that localization with vertical parallax was more successful overall than with magnification. Further analysis showed that while 90% of palatally impacted canines could be correctly detected with both techniques, less than half of the buccal canines could be detected with parallax and only 10% with magnification.

Another landmark study was performed by ***Maverna R and Gracco A*** in **2007**. They compared different radiographic diagnostic tools (orthopantomography (OPT), laterolateral and posteroanterior teleradiography, parallax method, laterolateral, occlusal radiography, computerized axial tomography, (cone beam CT) for localization of impacted maxillary canines, in four patients, highlighting the advantages and disadvantages of each. They evaluated the ease of use, dosage of radiation emitted, significance of localization of impacted canine, and cost of each method. Each method revealed the position of the canine with respect to the adjacent structures and the inclination of the major axis of the impacted tooth with respect to the plane of reference. Each technique presented intrinsic advantages and limitations; however they recommended cone-beam computed tomography for impacted canine localization as it provided elements which escape during traditional radiographic analysis and overlapping of structures on the film is prevented.

This study is an attempt to diagnose the position of the impacted maxillary canine utilizing and comparing two radiographic aids viz. vertical tube shift and vertex / true maxillary occlusal views. To evaluate the efficacy of these two radiographs, surgical intervention either for orthodontic repositioning or for surgical removal, was kept as the "gold standard".

The merits of the Vertical tube shift technique include - ease of equipment and material availability, the cost of the procedure and radiation exposure to the patient is minimal. It is less technique sensitive and easier to interpret by the examiner. The known limitation with this technique is the magnification error.

The alternative technique of vertex or true maxillary occlusal view is praiseworthy as it can be performed in any radiological clinic or dental clinic equipped with a general x-ray machine or cephalometric x-ray setup. It has nine fold reduction in x-ray skin dose and the primary x-ray beam is directed away from the thyroid and gonadal regions when compared with the conventional vertex/true occlusal radiography. The inherent high contrast of the film/screen/grid combination used in the alternative view gives the radiograph excellent contrast when compared with the vertex occlusal radiograph. Anecdotally, the film size used in the alternative technique allows for 90-second automatic processing, with minimal risk of losing the film in the automatic processor that may happen more often with occlusal films. Therefore the number of repeat examinations is reduced. Also, the alternative technique is very hygienic as nothing is introduced into the patient's mouth. There is less risk of transfer of infection.

The limitation with this technique is that patients with limited extension of the neck cannot be positioned accurately. This is true for patients with very short necks or neck disorders that prevent extension.

To comprehend and compare each of the radiographs with surgical intervention, a set of parameters were used, to prove the accuracy and prognosis of the superior radiographic technique. The results obtained by these parameters are as follows:

1. Position of cusp tip of canine in the maxillary arch – The cusp tip of the canine in relation to the maxillary arch was graded as Buccal, Palatal or On the Arch. Kappa analysis of this comparison revealed **91.6%** agreement between True maxillary occlusal view and surgical intervention; thus proving it to be ***more*** accurate & closer to results of surgical intervention than vertical tube shift technique **(74.5%).**
2. Position of root apex of canine - The root apex of the canine in relation to the maxillary arch was graded as Buccal, Palatal or On the Arch. Kappa analysis of this comparison revealed **87.5%**agreement between True maxillary occlusal view and surgical intervention; thus proving it to be ***more*** accurate & closer to results of surgical intervention than vertical tube shift technique (**21.9%**)
3. Relationship of the canine cusp tip and root of adjacent incisor – was graded as absent, crossing, overlapping, placed palatally or touching the surface of root of adjacent incisor. Kappa analysis of this comparison revealed **59.3%** agreement between True maxillary occlusal view and surgical intervention; thus proving it to be ***more*** accurate & closer to results of surgical intervention than vertical tube shift technique (**21.2%**).
4. Mesiodistal width of the crown of canine – was graded in millimeters. Paired t-test for this comparison revealed **0.5** differences in mean values of True maxillary occlusal view and surgical intervention; thus proving to be ***more*** accurate & closer to results of surgical intervention than vertical tube shift technique (**0.8**). The 'p' value for both the observations were borderline. So, results were borderline statistically significant. Thus, assessment of Mesiodistal width of the crown of canine was almost at par using either the True maxillary occlusal view or the vertical tube shift technique; but results with True maxillary occlusal view were marginally superior.
5. Length of the crown of canine (cusp tip to CEJ) – was graded in millimeters. Paired t-test for this comparison revealed **– 1.027** differences in mean values of True maxillary occlusal view and surgical intervention; thus proving it to be ***less*** accurate than vertical tube shift technique (**- 0.079**). The 'p' value for this observation set was **statistically significant**. So, length of the crown was better assessed with the vertical tube shift technique.
6. Distance of canine cusp tip from the mesioincisal edge of adjacent tooth – was graded in millimeters. Paired t-test for this comparison revealed **-0.094** differences in mean values of True maxillary occlusal view and surgical intervention; thus proving it to be ***more*** accurate & closer to results of surgical intervention than vertical tube shift technique (**5.219**). The 'p' value for this observation set was **not statistically significant**. So, distance of crown tip of canine from mesioincisal edge of adjacent incisor was better assessed with the True maxillary occlusal view.
7. Resorption of root of lateral incisor – Radiographically it was not possible to precisely comment on the resorption of the root of the adjacent teeth, in either of the radiographic techniques assessed in the study. Following surgical intervention i.e. exposure or removal, evaluation of root surface of adjacent teeth was compromised due to presence of osseous barrier or compromised visibility.
8. Curvature of root (dilaceration) – was graded as yes or no. Kappa analysis of this comparison revealed **76.9%** agreement between True maxillary occlusal view and surgical intervention; thus proving it to be ***less*** accurate than vertical tube shift technique (**85.2%**). Thus, curvature of root was better assessed with vertical tube shift technique.

In conclusion, the true maxillary occlusal view was superior to vertical tube shift technique in 6 out of 8 parameters studied, although in 2 of the parameters i.e. length of the crown of the canine and curvature / dilacerations of the root apex, Vertical tube shift technique provided better results.

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