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EFFECT OF DIFFERENT ANGULATIONS OF IMPACTED MAXILLARY CANINE ON ROOT RESORPTION OF ADJACENT TEETH USING CONE BEAM COMPUTED TOMOGRAPHY: A RETROSPECTIVE STUDY

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KEYWORDS

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Root resorption

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ABSTRACT

Introduction: Permanent maxillary canine impaction is a common problem. Impacted canines can cause variable degrees of resorption on the roots of surrounding teeth, particularly the lateral incisors**. Aim:** The objective of this study was to evaluate the effect of different angulations of impacted maxillary canine on root resorption of adjacent teeth using cone-beam computed tomography (CBCT). **Materials and Methods:** The sample included 30 CBCTs presenting with unilateral or bilateral impacted maxillary canines, ranging in age from 15 to 30 years that were collected. from the Department of Radiology, Faculty of Dentistry, Suez Canal University. Canine angulation relative to the maxillary occlusal plane and adjacent lateral incisor was measured, as well as the locations of the impacted canines. **Results:** The results of the current study showed (58.8 %) with slight resorption and (26.5%) with moderate resorption of lateral incisor root. There was a statistically significant relationship between root resorption severity and angulation of impacted maxillary canine relative to the lateral incisor. The angle of the impacted maxillary canine with the occlusal plane can`t solely rely on determining the severity of root resorption (RR). **Conclusion:** RR occurs due to the proximity of the impacted maxillary canine to the adjacent lateral incisor KEYWORDS: Cone beam computed tomography, Impacted canine, Lateral incisor Root resorption.

INTRODUCTION

An impacted tooth fails to erupt at its proper location in the dental arch during its normal eruption period [(1)]. Maxillary canines are the most frequently impacted teeth after third molars, with a prevalence ranging from 0.9 to 3.0% depending on the population studied [(2)]. The position of impacted canines reported by different authors varies, but in most studies, the canines are located palatally (41%-90%). Impacted maxillary canines have been shown to occur twice as commonly in females than males [(3)].

Different radiographic exposures, such as occlusal films, panoramic views, and lateral cephalometric radiographs, can aid in determining canine position. Due to superimposition issues, traditional radiographs can be somewhat limited in their ability to visualize impacted teeth. Three-dimensional (3D) volumetric imaging systems with excellent tissue contrast enable the localization of impacted canines using

spatial relationships Cone beam computed tomography(CBCT) uses a cone-shaped X-ray to acquire maxillofacial images with higher spatial resolution and lower radiation dose than conventional CT [4].

Root resorption (RR) of adjacent teeth, particularly the lateral incisors, is the most common undesirable, irreversible, and adverse sequela of maxillary canine impaction, causing irreversible damage and potentially leading to tooth loss [5]. Traditional methods of detecting resorption can be difficult; however, advances in (CBCT) have significantly improved the sensitivity and accuracy of the RR diagnosis.

CBCT may influence treatment planning and may be a genuine method for correcting a suggested treatment for incisor RR, providing more reliable information than traditional methods [6].

So this study was planned to evaluate the effect of different angulations of impacted maxillary canine on the root resorption of adjacent teeth using cone-beam computed tomography.

MATERIALS AND METHOD

The study design:

In this retrospective study, Thirty CBCT scans of patients with unilateral or bilateral impacted maxillary canines ranging in age from 15 to 30 years old were collected from the archive of the Oral Radiology Department, Faculty of Dentistry, Suez Canal University. The study was approved by the Research Ethics Committee of Suez Canal University to be conducted with an ethical code number approval **(363/2021**). Using the same standard protocol, all CBCT scans were taken using Soredex SCANORA 3D* and handled by OnDemand Imaging Software.

1. Impacted maxillary canine localization (bucco-palatal position) :

From a CBCT axial view, and relative to the most central line of the maxillary arch; the buccolingual maxillary canine position is determined as: palatal (If more than half of the canine crown was located palatally), labial (If more than half of the canine crown was located labially) or in line with the arch (If the canine crown was located at central line) [7]. Figure 1(A)

2. Canine angulation relative to maxillary occlusal plane

- The occlusal plane was defined as the line from the mesiobuccal cusp of the maxillary first molar to the incisal edge of the maxillary central incisor [8].
- From a clear panoramic view of the impacted canine, we measure the angle formed between the canine's long axis and the occlusal plane**.** (Figure 1B).

3. Canine angulation relative to maxillary lateral incisor

- From a clear panoramic view of the impacted canine, we measure the angle between the long axis of the impacted canine and adjacent teeth. (Figure 1C)

4. Severity of root resorption according to Ericson and Kurol (2000)9 graded as:

- No resorption (Figure 2 A)
- Slight: resorption up to half the dentine thickness. (Figure 2B)
- Moderate: resorption of the dentine midway to the pulp or more, the pulp lining being unbroken. (Figure 2 C)
- Severe: resorption affecting the pulp

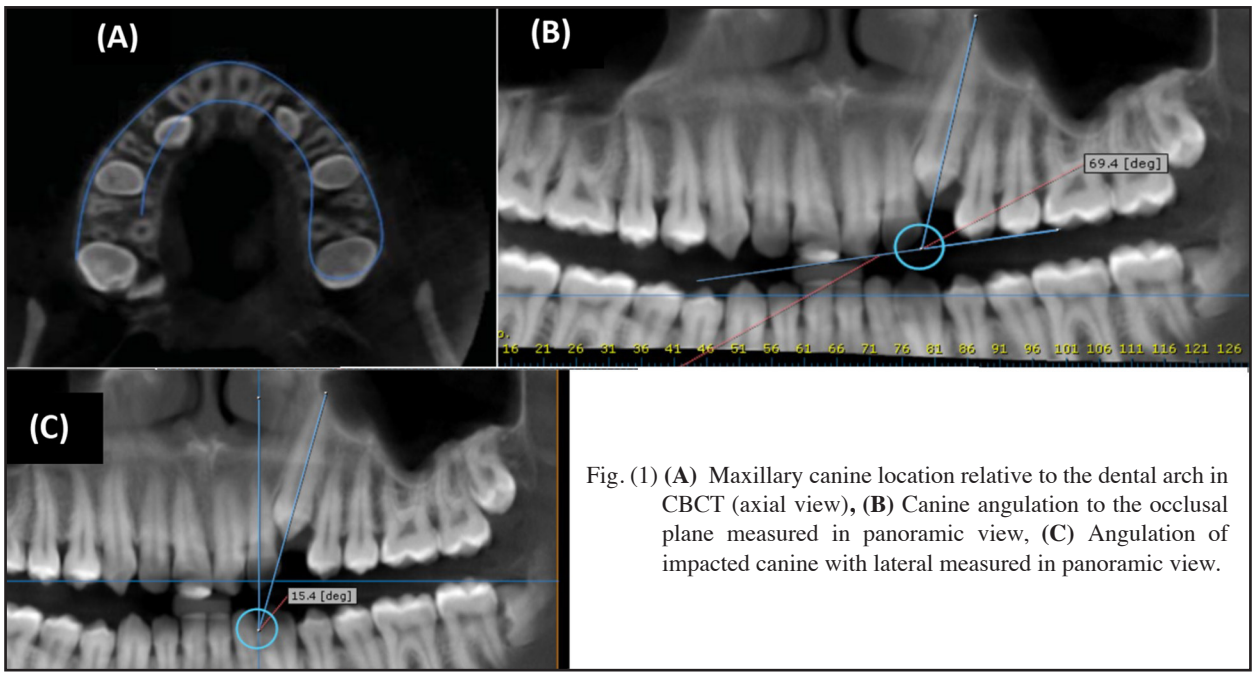

Fig. (1) **(A)** Maxillary canine location relative to the dental arch in CBCT (axial view)**, (B)** Canine angulation to the occlusal plane measured in panoramic view, **(C)** Angulation of impacted canine with lateral measured in panoramic view.

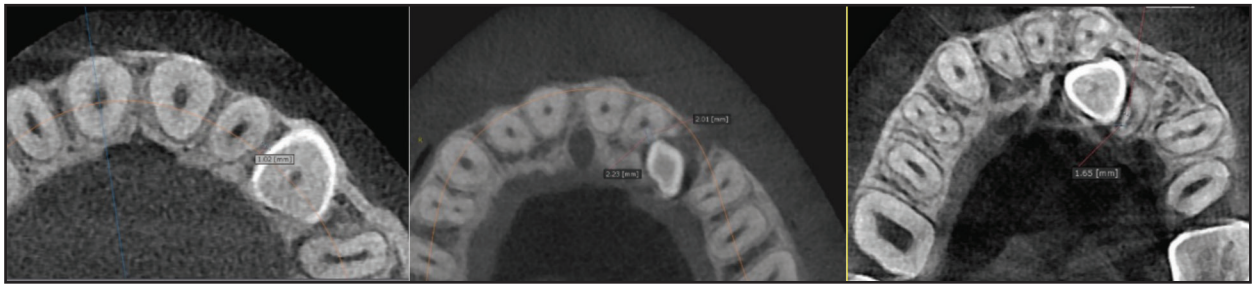

Fig. (2) **(A)** No resorption—intact root surfaces. There is no contact between the lateral incisor and the impacted canine with a distance of 1.02 mm, **(B)** Slight resorption up to half dentine thickness, **and (C)** moderate resorption.

RESULTS

Thirty CBCT presented with 34 impacted maxillary canines. Unilateral impaction was presented in 26 (86.6%) and 4 (13.3%) scans presented with bilateral impact. The three-dimensional location analyses revealed that the majority of the impacted canines were located in the palatal position 15 (44.1%),13 (38.2%) were located buccally and only 6 canines (17.6%) showed the line of occlusion canine position. In this sample,5(14.7%) impacted maxillary canines causing no resorption. 20 (58.8%) caused slight resorption. 9 (26.5%) caused moderate resorption**.** (Table 1)

Table (1) *Severity of root resorption on adjacent lateral incisor (34 observations)*

Severity of resorption	Frequency (n=34)		n=34		Sign.
	N	%	Mean	SD	
No	5	14.7	1.2	0.5	<0.001 ***
Slight	20	58.8			
Moderate	9	26.5			
Severe	0	0			

***, *Significant at p<0.001*

Regarding the correlation between root resorption severity and angulation of impacted maxillary canine relative to the lateral incisor, there is a strong positive and highly significant correlation between the severity of root resorption and the angulation of the impacted maxillary canine with the lateral incisor**.** (Table 2)

Table (2) *The correlation between root resorption severity and angulation of impacted maxillary canine relative to the lateral incisor*

Severity	Angulation with lateral incisor			
	N (%)	Mean	SD	Posthoc
No	5 (14.7)	10.0	3.1	A
Slight	20 (58.8)	38.5	8.2	B
Moderate	9 (26.5)	72.7	27.3	A
Severe	0 (0.0)	0	0	A
ANOVA	<0.001***			
Correlation	r= -0.279; p<0.112ns			

****, Significant at p<0.001*

Regarding the correlation between root resorption severity and angulation of impacted maxillary canine relative to the occlusal plane, there is a weak non-significant correlation between severity of root resorption and angulation of impacted canine with occlusal plane. (Table 3)

Table (3) *The correlation between Severity of root resorption and angulation of impacted maxillary canine with the occlusal plane*

Severity	Angulation with the occlusal plane				
	N	%	Mean	SD	DMRTs
No	5	14.7	52.2	25.5	a
Slight	20	58.8	46.9	13.8	a
Moderate	9	26.5	55.8	11.5	a
Severe	0	0	0.0	0.0	a
ANOVA	>0.05 ns				
Correlation	r= 0.167; p=0.345 ns				

NS non-significant at p>0.05

DISCUSSION

The canine is the cornerstone of the dental arch. It is critical for facial attractiveness, dental aesthetics, arch development, and functional occlusion so one of the therapeutic aims in every treatment plan is a well-positioned canine in the dental arch. Impacted maxillary canines are the second most impacted tooth after the third molar teeth because it has the longest path of eruption [8]. Impacted canines are one of the most difficult malocclusions that face the orthodontist so some studies tried to understand the path of its eruption to early predict its impaction and hence early intervention to prevent impaction of the canine [9,10,11]. Root resorption (RR) of adjacent teeth, particularly the lateral incisors, is the most common undesirable, irreversible, and adverse sequela of maxillary canine impaction, causing irreversible damage and potentially leading to tooth loss [6,12]. Resorption can be difficult to diagnose using traditional methods; however, advances in cone beam computed tomography (CBCT) have significantly improved the sensitivity and accuracy of the RR diagnosis [12,14].

The goal of this study was to use cone-beam computed tomography to assess the effect of different angulations of an impacted maxillary canine on root resorption of adjacent teeth.

The age range in this study ranged from 15 to 30 years old. This was selected beyond the average eruption date of the canine to ensure its impaction. It was suggested that if the maxillary canine has not. Erupted at the age of 13.1 years in boys or 12.3 years in girls, it can be considered impacted [15].

Two-dimensional radiographs may underestimate the problem because root resorption becomes visible only when the entire thickness of the root surface is damaged, from the lingual to the buccal

surface, or when it has progressed sufficiently to alter the mesiodistal profile of the root. Resorption is also difficult to detect on orthopantomograms due to incisor and canine overlapping, and because the degree of resorption should be compared to the initial thickness of the root [11,16]. The CBCT has largely replaced other diagnostic techniques because of its accuracy in both localizations of canine impaction and identification of any associated complications as root resorption, which may alter treatment plans for orthodontists [14]. Moreover, CBCT radiographs have eliminated superimposed structures that may interfere with identifying reference points of measurements [17,18,19].

In this study, the samples were selected randomly and the CBCT scans that show Craniofacial anomalies or syndromes, Low resolution that preclude accurate measurements, Extraction cases or presence of supernumerary teeth, and X-rays with limited field of view were precluded

The most common adverse effect of impacted maxillary canines is lateral incisor root resorption. Any level and surface of the tooth can be affected by root resorption. In a study, slight root resorption was the most common level of RR severity at 58.8% followed by moderate resorption at 26.5%, this was in agreement with **Dogramaci et al [21].**

We correlated the severity of root resorption and angulation of the impacted maxillary canine with lateral incisor and the angle between the impacted maxillary canine and occlusal plane. Regarding. Angulation of impacted maxillary canine with lateral incisor, our study supported other research which reported that the severity of root resorption increased as the angle between the long axis of the impacted maxillary canine and the long axis of lateral incisor with mean angle 43.3. This was in agreement with, **Alqerban et al. [8], Kalavritinos et al. [20], Guarnieri et al. [22] , and Simić et al [23].**

Regarding angulation between the impacted maxillary canine and occlusal the plane, our study reported that the Angle of the impacted maxillary canine with the occlusal plane has no role in the amount of root resorption of the adjacent tooth. There may be another factor other than angulation of the impacted maxillary canine with occlusal plane affecting the severity of root resorption such as the proximity of the impacted canine to the lateral incisor. This was in agreement with **Guarnieri. et al. [22] and Simić et al. [23].**

Finally, orthodontists can help the canine erupt in the proper location and reduce the risk of complications associated with an impacted maxillary canine by detecting it early, intervening in time, and providing well-managed treatment with proper direction of orthodontic traction.

CONCLUSIONS

1. The most common adverse effect of impacted maxillary canines is lateral incisor root resorption.
2. The most common level of RR severity was slight at 58.8% followed by moderate resorption at 26.5%
3. There is a positive correlation between the appearance of resorption on the lateral incisor and the angle between the axis of the canine and adjacent lateral incisor with a mean angle of 43.3
4. The angle of the impacted maxillary canine with occlusal plane can`t be solely relied on determining the severity of RR

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