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Evaluation Incisors Size and their Relationship to Displacement of the Maxillary Canine by Computerized Tomography Images in Yemeni Females

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Abstract

Background and objective: The present study provides valuable insights into the three-dimensional positioning of impacted maxillary canines and the associated mesiodistal dimensions of maxillary incisors in female patients. The objective of this study is to investigate the potential correlation between the displacement of impacted maxillary canines and the dimensions of the adjacent incisors. ***Material and methods:*** The sample consisted of pretreatment CBCT images of 28 females Yemeni, with palatal canine or buccal canine displacement (PDC or BDC) unilateral or bilateral, females with mean for aged 23.3± 2.1 years. An independent samples t-test was conducted to examine whether there is statistically significant difference between the means of two independent groups on two different variables. ***Results:*** The findings indicate that a significant correlation exists between the positioning of impacted canines and the dimensions of adjacent incisors. Specifically, patients with buccally displaced canines (BDC) exhibited larger mesiodistal crown sizes of maxillary incisors, suggesting a potential predictive marker for this type of canine displacement. In contrast, those with palatally displaced canines (PDC) demonstrated a significant reduction in incisor width, indicating a trend towards smaller tooth dimensions. This observation challenges the prevailing notion that spatial limitations are the primary cause of palatal impaction, as these cases often occur in individuals with adequate arch space. ***Conclusion:*** The contrasting incisor dimensions between the BDC and PDC groups underscore the importance of early morphological assessments in predicting canine eruption patterns. These insights can enhance diagnostic accuracy and inform individualized treatment planning in orthodontics, particularly for female patients who are more susceptible to canine impaction. Future research should further explore the implications of these findings on treatment outcomes and the underlying biological mechanisms influencing canine eruption.

Keywords: Cone-Beam Computed Tomography, Canine Impacted, Palatal, buccal, tooth size.

INTRODUCTION

Tooth displacement refers to the abnormal intraosseous positioning of a tooth particularly the canine at the expected time of eruption. Among these, palatal displacement of the maxillary canine is notably more common, especially in females, with palatal impactions occurring approximately twice as frequently as buccal ones [1,4]. Tooth impaction, on the other hand, is defined as the failure of a tooth to erupt within its expected timeframe [1].

Early detection of maxillary canine displacement is crucial for preventing impaction. This requires a thorough understanding of the eruption timeline and the correct anatomical pathway for each tooth. The present article explores various methods for locating canines that deviate from their normal eruption course [5].

Cone-beam computed tomography (CBCT) has significantly enhanced radiographic imaging by addressing the limitations of conventional two-dimensional techniques. Studies have extensively validated the precision, accuracy, and reliability of CBCT in identifying anatomical landmarks and performing linear and angular measurements [6,9], including the localization of ectopic teeth [10,12].

CBCT imaging has proven valuable in several clinical applications:

- Diagnosis of impacted and supernumerary teeth, where 3D imaging surpasses traditional 2D methods [13,15].
- Planning for skeletal anchorage devices, allowing assessment of bone thickness and density in both jaws [16,18].
- Volumetric analysis of the upper airway, aiding in respiratory evaluations [19].
- Orthodontic and orthognathic treatment planning, offering detailed anatomical insights [20].

CBCT measurements have demonstrated high reliability, independent of object positioning or examiner experience, with strong reproducibility across repeated assessments [21]. Systematic errors were evaluated using paired t-tests, revealing a mean difference of 1.1 and a standard deviation of 0.04. A reliability coefficient of 0.9 indicated no significant impact on the study's interpretive outcomes.

Impacted canines can lead to undesirable consequences such as migration of adjacent teeth, reduction in arch length and width, and in some cases, the development of cysts, tumors, or infections. One of the most critical complications is root resorption of neighboring teeth, which can compromise their long-term viability [22]. This process is often asymptomatic, and by the time it is clinically detected, it may have progressed beyond the point of conservative intervention [23,24]. The objective of this study is to investigate the potential correlation between the displacement of impacted maxillary canines and the dimensions of the adjacent incisors.

MATERIAL AND METHODS

This study was conducted on 28 patients diagnosed with unilateral or bilateral maxillary canine displacement, whose Cone Beam Computed Tomography (CBCT) images were reviewed at two radiology imaging centers in Sana'a City, Yemen. The patients were diagnosed with maxillary canine impaction between 2019 and 2023. To ensure accurate diagnosis, data were collected, including the relevant computed tomography images. The criteria for diagnosing evident maxillary canine impaction included: (1) an unerupted canine present for more than one year after the eruption of all permanent teeth; (2) unilateral or bilateral maxillary canine impaction as evidenced by CBCT images; and (3) the sample comprised female patients with a mean age of 23.3 ± 2.1 years.

All CBCT images were oriented and standardized using the Pax-Flex3DP2 software (Vatech, Korea). The bucco-palatal position of the impacted canines was determined on the computed tomography images, using the size of the incisors as a reference. Palatal impaction was defined as the canine crown tip being positioned more palatally than the root of the lateral incisor, while buccal impaction was defined as the opposite positioning. A total of 36 impacted canines were identified among the subjects, which were divided into two groups: Group One consisted of 22 palatally impacted canines, and Group Two included 14 buccally impacted canines. All cases had aligned incisors and complete root development of the impacted canines.

The following measurements are recorded from the pretreatment CBCT image: Shown figure 1 table (1).

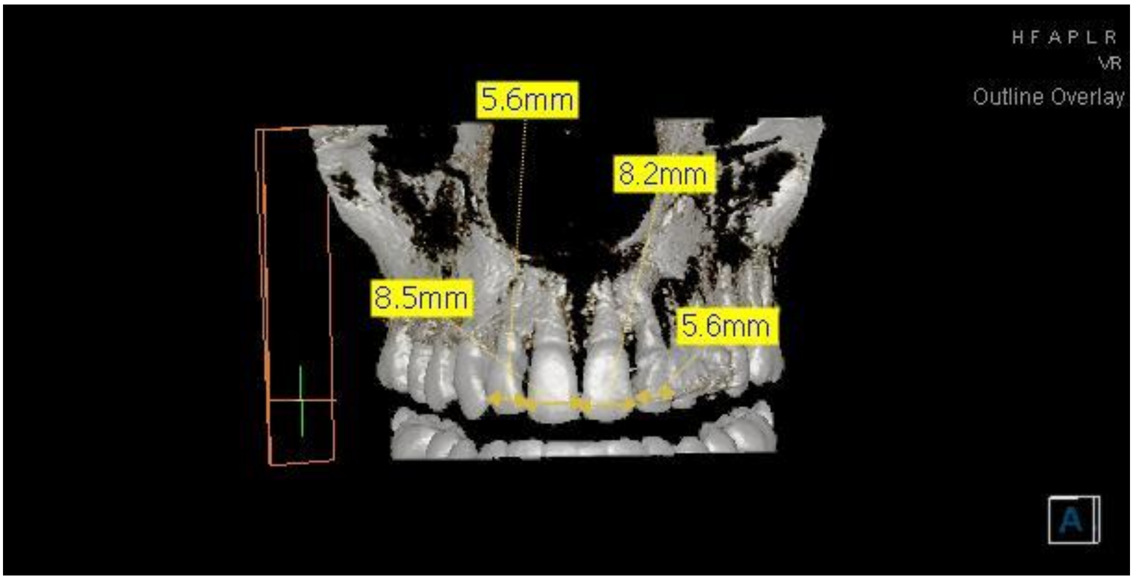

Figure 1:

Table 1:

UIMD (C)	Upper central incisor maximum mesiodistal width at cervical.
UIMD (C.P)	Upper central incisor maximum mesiodistal width at contact.
U2MD (C)	Upper lateral incisor maximum mesiodistal width cervical
U2MD (C.P)	Upper lateral incisor maximum mesiodistal width at contact.
BDC	Canine displacement buccally
PDC	Canine displacement palatally

Statistical analysis:

Tooth size data obtained from the CBCT images of patients with palatally displaced canines (PDC) and buccally displaced canines (BDC) were compared to a reference sample. An independent samples t-test was conducted to assess whether there were statistically significant differences between the means of the two independent groups across two different variables. This analysis aimed to determine if group membership influenced the measured outcomes.

RESULTS

The study included 28 female participants with a mean age of 23.3 ± 2.1 years. The mean measurements for the mesiodistal crown diameter of the incisors, along with their ranges and standard deviations, are presented in Table 2. Levene's test for equality of variances indicated that the assumption of equal variances was satisfied, with a significant value of 0.81 ($P > 0.05$). Therefore, the results of the t-test were interpreted using the row for "Equal variances assumed."

The independent samples t-test revealed no statistically significant difference between the means of the two groups for the first variable, as the P-value was greater than 0.05 and the confidence interval included zero. However, for the second variable, the P-value was less than 0.05, and the confidence interval did not include zero, indicating a significant difference between the groups.

In conclusion, the independent samples t-test indicated that BDC exhibited a slightly statistically significant difference in mesiodistal dimensions at the cervical region of the lateral incisor compared to PDC, as shown in Table 3. These results suggest that group membership may influence outcomes for certain variables, while no significant differences were observed for others.

Table 2:

MD width		Displacement of Canine	N	Mean	Std. Deviation	Std. Error Mean
At Cervical	2 R	PDC	23	5.8913	.45117	.09408
		BDC	13	5.5000	.45644	.12659
	1 R	PDC	23	5.7836	.36388	.07587
		BDC	13	5.8077	.521195	.14478
	2 L	PDC	23	5.7836	.36388	.07587
		BDC	13	5.8077	.52195	.14476
	1L	PDC	23	5.1087	.42524	.08867
		BDC	13	5.0385	.37978	.10533
At contact	2 R	PDC	23	6.8696	.30960	.06456
		BDC	13	6.8846	.29957	.08309
	1 R	PDC	23	9.6087	.47569	.09919
		BDC	13	9.3077	.32522	.09020
	2 L	PDC	23	9.5-87	.47569	.09919
		BDC	13	9.3077	.32522	.09020
	1L	PDC	23	6.8696	.30960	.06456
		BDC	13	6.8846	.29957	.08309

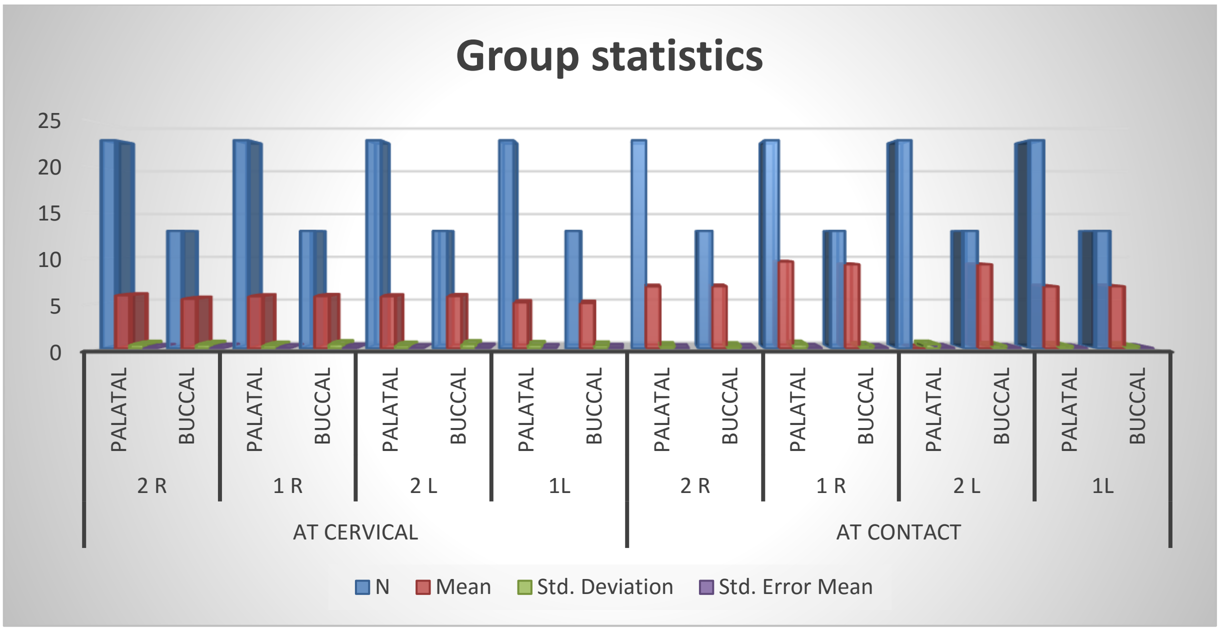

Table 3:

Independent Samples Test										
		Levene's test Equality of \variances					T-test for Equality of means		95%confidence Interval of the difference	
MD		F statistic	Sg. More than 0.05	t-test	df	Sig.(2tailed) Less than 0.05	Mean deference	Std. Error deference	Lower	Upper
2 R {C}	Equal variances assumed	3.230	.081	-1.401	34	.170	-.22500	.16065	-.55148	.10148
	Equal variances not assumed			-1.430	33.934	.162	-.22500	.15731	-54472	.09472
1 R {C}	Equal variances assumed	1.830	.185	2.247	34	.031	-.30000	.13352	.02866	.57134
	Equal variances not assumed			2.212	29.989	.035	-.30000	.13564	.02298	.57702
2 L {C}	Equal variances assumed	1.830	.185	2.247	34	.031	-.30000	13352	.02866	.57134
	Equal variances not assumed			2.212	29.989	.035	-.30000	.13564	.02298	.57702
1L {C}	Equal variances assumed	.195	.662	-.136	34	.893	-.01875	.13790	-.29899	.26149
	Equal variances not assumed			-.138	33.807	.891	-.01875	.13550	-.29419	.25669

2 R (C.P)	Equal variances assumed	.016	.899	.000	34	1.000	.00000	.10270	-.20871	.20871
	Equal variances not assumed			.000	33.442	1.000	.00000	.10152	-.20645	.20645
1 R (C.P)	Equal variances assumed	.010	.922	2.887	34	.007	.39375	.13639	.11658	.67092
	Equal variances not assumed			2.886	32.266	.007	.39375	.13641	.11598	.67152
2 L (C.P)	Equal variances assumed	.010	.922	2.887	34	.007	.39375	.13639	.11658	.67092
	Equal variances not assumed			2.886	32.266	.007	.39375	.13641	.11598	.67152
1L (C.P)	Equal variances assumed	.016	.899	.000	34	1.000	.00000	.10270	-.20871	.20871
	Equal variances not assumed			.000	33.442	1.000	.00000	.10152	-.20645	.20645

DISCUSSION

The present study aimed to perform a three-dimensional evaluation of impacted maxillary canine positioning, alongside an assessment of the maximum mesiodistal width of the maxillary incisors. Consistent with previous literature, impacted canines were found to be more prevalent among female patients [13,19,25,27]. One of the primary etiological factors contributing to maxillary canine displacement is the mismatch between tooth size and available arch length[28]. Given the critical role of the maxillary canine in facial aesthetics, dental harmony, arch integrity, and functional occlusion, its eruption path—being longer and more complex than other teeth—makes it particularly susceptible to eruption disturbances [29,30].

Due to known gender-based differences in crown morphology and mesiodistal dimensions of the labial surface of incisors [31,32], this study focused exclusively on CBCT scans from female subjects to ensure consistency in measurement and interpretation. The findings revealed a statistically significant increase in the mesiodistal crown size of maxillary incisors in patients with buccally displaced canines (BDC), suggesting a generalized pattern of larger tooth dimensions in this group. This trend may serve as a predictive marker for BDC cases.

Conversely, patients with palatially displaced canines (PDC) exhibited a statistically significant reduction in mesiodistal width of the maxillary incisors, indicating a tendency toward smaller tooth size. These results align with previous studies, such as those by Jacoby [33] and Langberg [34], which reported that PDC often occurs in individuals with adequate dentoalveolar arch space and normal arch form. Notably, these cases were not associated with crowding or arch length deficiency [35], challenging the assumption that spatial limitations are the primary cause of palatal impaction.

The contrast in incisor dimensions between BDC and PDC groups underscores the importance of early morphological assessment in predicting canine eruption patterns. These insights may contribute to more accurate diagnostic protocols and individualized treatment planning in orthodontics, particularly in female patients who are statistically more prone to canine impaction.

LIMITATION

While this study provides valuable insights into the positioning of impacted maxillary canines and the associated dimensions of maxillary incisors, several limitations should be acknowledged:

1. Sample Size and Demographics: The study focused exclusively on female patients, which may limit the generalizability of the findings to male populations. A larger and more diverse sample that includes both genders could provide

a more comprehensive understanding of canine impaction patterns.

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