Original Article

Association of Impacted Maxillary Canines with Root Resorption of Adjacent Teeth - A Radiographic Retrospective Study

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ABSTRACT

Objective: The study aims to record the grade of resorption in maxillary teeth in patients with impacted maxillary canines.

Study Design: A retrospective radiographic study

Place and Duration of Study: This study was conducted at the College of Dentistry, Qassim University, Buraydah, Qassim, Saudi Arabia from June 2022 and February 2024.

Methods: We collected a number of 4500 panoramic radiographs from the Radiographic Department at the dental clinics of the College of Dentistry, Qassim University. Patients ≥12 years old with good-quality panoramic radiographs were included. The root resorption severity was categorized into 4 groups (no, mild, moderate, and severe resorptions). The location of the impacted maxillary canine was divided into 5 sectors. Chi-squared test was used to identify any significant differences between genders. The Kappa test was used to assess the Intra-rater reliability for the severity of root resorption. The level of significance was set at $P < 0.05$.

Result: A number of 19 impacted maxillary canines caused mild to severe resorption of the lateral incisors (n=17, 89.5%) and central incisors (n=2, 10.5%). The prevalence of root resorption of adjacent teeth was 17.3%. There were 12 males (66.7%) and 6 females (33.3%) affected with root resorption, with a significant difference detected (p=0.01) between the two genders. Most of the root resorption occurred with impacted canines in sectors 1 and 2 (79%).

Conclusions: Impaction of maxillary canines occurred more in males than females. The root resorption occurred more frequently in male compared to female patients with highly significant differences. The most affected teeth were lateral incisors (89.5%).

Key Words: Impacted, Resorption, Canines, Roots, Panoramic Radiography, Tooth

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INTRODUCTION

Teeth are considered impacted when they stay embedded in the jaw and past their expected time of eruption [1]. Impacted maxillary canines are a common issue in dental practice with a prevalence of 1-3%[2]. The presence of impacted teeth in an orthodontic patient carries a great concern for orthodontists[3]. The clinical and radiographical diagnosis and localization of impacted canines are sometimes challenging.

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The effect of embedded teeth on the roots of the adjacent teeth should be examined carefully before attempting an orthodontic or surgical management[4]. The absence of good monitoring and a postponement in the impacted canine treatment can result in several complications, including teeth displacement, follicular cysts, loss of vitality in nearby teeth, recurrent infections and pain, canine ankyloses, shortening of the dental arch, internal and external resorption of the canine and the neighboring teeth, and a combination of these factors [5–7]. Such unwanted outcomes are probably avoidable with the help of an adequate diagnosis, precise analysis, and early action [8].

Loss of dental cementum and dentin linked to physiological and pathological activities of the tooth-resorbing cells is referred to as root resorption[9]. Impaction of the maxillary canine occurs frequently during the permanent dentition development. Root resorption of neighboring teeth is the most frequent and unfortunate consequence [10,11]. This resorption, often asymptomatic and gradually resorbing the roots of the incisors, usually goes unnoticed until detected on X-rays. Accurately assessing the root resorption is crucial, as numerous factors influence treatment options and

prognosis. The best course of treatment depends on the extent of resorption, severity of impaction, and overall dental health. Knowing whether incisor resorption has occurred is particularly critical, as it significantly impacts tooth extraction strategies. When root resorption is discovered prior to the start of orthodontic therapy, a choice must be made regarding whether to extract the resorbed tooth or to move the impacted canine away from the resorbed tooth. Extraction of the resorbed tooth would be followed by orthodontic alignment of the impacted canine, closure of the gap, and reshaping [12,13]. Improper force application and direction during this process can cause further resorption.

Another crucial component to evaluate in a clinical case with root resorption is the severity of root resorption. The extent of root resorption was classified into four categories by a researcher. If the resorption is severe, extraction of the affected teeth and realignment might be the best choice of treatment; since the resorption is permanent. The proximity and cusp position of the impacted canine is also an important factor to evaluate[10]. Impacted canines in sectors 1 and 2 have a chance of self-correction, emerging on their own; while impacted canines in sectors 4 and 5 are difficult to align with orthodontic appliances.

The current study aims to investigate the severity of root resorption on maxillary teeth in patients with impacted maxillary canines. The frequency, correlation and severity of root resorption in each sector will be documented.

METHODS

Ethical approval was received from the Committee of Research Ethics, Deanship of Scientific Research, Qassim University (Date: 27 March 2022 – Number: 21-14-04). A number of 4500 (2500 males and 2000 females) panoramic radiographs were obtained from the Radiographic Department at the dental clinics of the College of Dentistry, Qassim University. Panoramic radiographs were taken with a Soredex CRANEX Novus machine (Soredex, Helsinki, Finland).

Inclusion criteria involved patients ≥12 years old with good-quality panoramic radiographs. Patients with syndromes, such as cleft lip and palate, pathological conditions in the interested area, and previous history of fracture of the maxilla or orthodontic treatment, were excluded.

To understand the relationship between impacted maxillary canines and root resorption, we gathered some key details from each participant, such as: date of X-ray, file number, age, gender, presence of hereditary diseases, local pathological conditions, presence of impacted maxillary canines, and the degree of root resorption. The severity of root resorption and position of impacted canines were classified according to researcher classification. The root resorption was classified into four categories: the first category was no signs of root resorption (=0), followed by mild resorption (=1, where half of the dentin was resorbed), moderate resorption (=2, where most of the dentin was resorbed, but the pulp is intact), and severe resorption (=3, where the pulp was exposed). Ericson and Kurol, 1988, divided the position of impacted maxillary canines into 5 sectors. Figure illustrates the 5 different sectors introduced by a researcher.

An orthodontist examined the panoramic radiographs to assess the severity of root resorption. To assess the Intra-rater reliability, all samples were re-evaluated after a month of the initial evaluation [7].

Descriptive statistics, including the number of root resorption occurrences and percentages, were used to report the results. The Kappa test was used to assess the Intra-rater reliability for the severity of root resorption and the position of the canine tip (sector). Spearman's correlation test was applied to examine the correlation between the sectors and root resorption of adjacent teeth. To identify any significant differences between genders we used the Chi-squared test. The level of significance was set at $P < 0.05$. All statistical analyses were carried out using SPSS (IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp).

RESULTS

We identified 82 cases of patients with impacted canines. The total number of impacted teeth was 110 with a prevalence of 2.4%. The included panoramic radiographs were taken between 2018 and 2022. The mean age of the study population was 25.9 (SD ± 12.3). Interestingly, we found a slightly higher number of impacted canines in males (56.1%) compared to females (43.9%) with a M:F ratio of 1.28:1. Although more males were affected, this difference was not statistically significant (df=1, p=0.238).

A number of 19 impacted maxillary canines in 18 patients caused mild to severe resorption of the lateral incisors (n=17, 89.5%) and central incisors (n=2, 10.5%). The prevalence of root resorption of adjacent teeth was 17.3%. There were 12 males (66.7%) and 6 females (33.3%) affected with root resorption. There was a significant difference detected between males and females (p=0.01). Figure No**.1** shows an example of root resorption on the adjacent lateral incisor. Table No***.1*** shows the frequency and correlation of impacted canines in the different sectors and the degree of resorption on adjacent teeth. The frequency and degree of root resorption in each sector are shown in Table *No**.2***. There was a significant correlation between sector 2 and root resorption of adjacent teeth (p=0.002).

The Intra-rater reliability for the degree of root resorption and location of the impacted canines were considered high, with percentages of 85% and 100%, respectively.

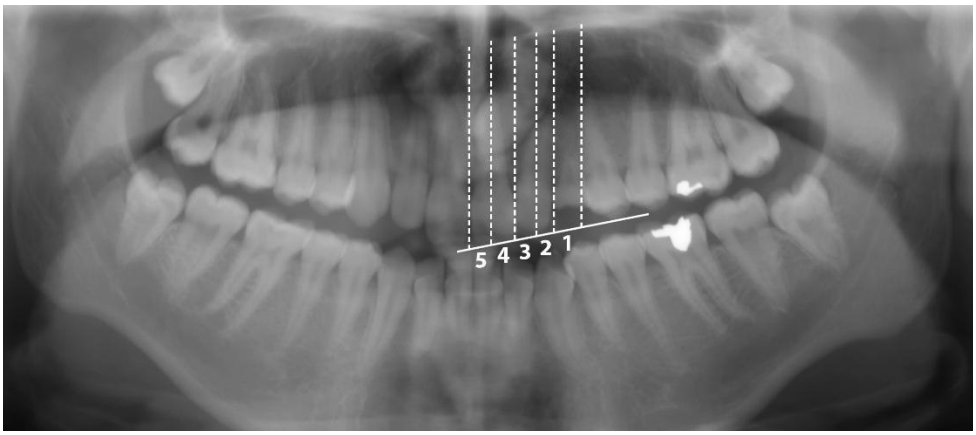

Figure No.1: shows the 5 sectors introduced by Ericson and Kurol in 1988. The impacted canine, in this case, is located in sector 5, as the tip of the impacted maxillary canine has passed the midline of the maxillary central incisor.

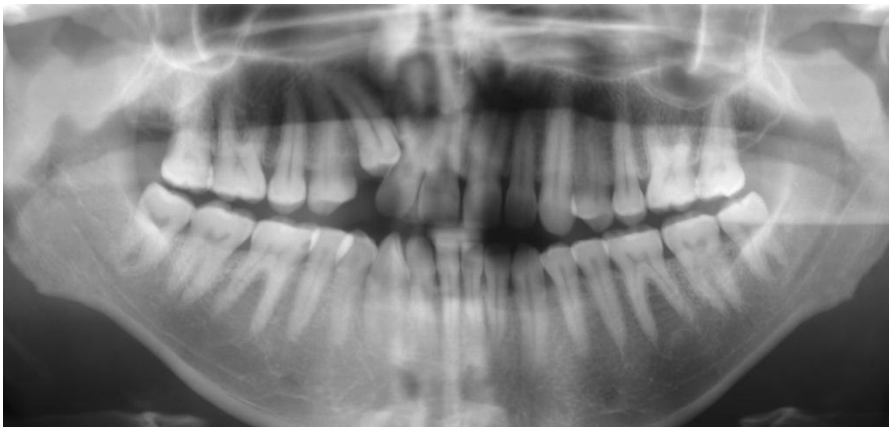

Figure No.1: shows an impacted maxillary right canine. The impacted tooth has forced the root of the upper right lateral incisor to tip mesially with evident root resorption on the distal side.

Table No. 1: The overall frequency of sectors and degree of resorption.

Sectors	**1**	**2**	**3**	**4**	**5**	**Total**
Number (%)	36 (32.7)	26 (23.6)	19 (17.3)	15 (13.6)	14 (12.8)	110 (100)
Degree of resorption	**No resorption**	**Mild**	**Moderate**	**Severe**	**Total**	
Number (%)	91 (82.7)	12 (10.9)	4 (3.6)	3 (2.8)	110 (100)	

Table No.2: The frequency and correlation of root resorption in each sector.

Sectors/Degree of resorption	**1**	**2**	**3**	**4**	**5**	**Total**
Mild	3	7	0	1	1	12 (63.2%)
Moderate	0	4	0	0	0	4 (21.0%)
Severe	0	1	0	2	0	3 (15.8%)
P value (correlation)	0.084	0.002*	0.910	0.084	0.72	
Total	3 (15.8%)	12 (63.2%)	0 (0%)	3 (15.8%)	1 (5.2%)	19 (100%)

*** Indicates significant difference at the 0.05.**

DISCUSSION

The maxillary canine is often impacted during the development of permanent dentition. Knowing the risks of impacted maxillary canines, especially their tendency to dissolve the roots of neighboring teeth, highlights the importance of early detection and intervention to prevent lasting damage [11].

During the incidence of canine impaction, the most important part is determining whether or not root resorption occurred in the adjacent teeth. A number of 4500 panoramic radiographs were obtained from the Radiographic Department at the dental clinics of the College of Dentistry, Qassim University. Our study employed clear participant selection criteria to ensure the validity and generalizability of our findings. One of

the inclusion criteria was to involve patients ≥12 years old. This age guarantees accurate assessment of impaction and root resorption due to the complete development of permanent teeth at this age. Additionally, excluding patients with specific conditions such as cleft lip and palate, jaw fractures, and prior orthodontic treatment minimized extraneous factors that could potentially influence the degree and incidence of root resorption on adjacent teeth. This meticulous selection process strengthened the internal validity of the study and enhanced the trustworthiness of our conclusions. By carefully selecting participants, we built a reliable foundation for our study, leading to valuable insights and ultimately better diagnosis for impacted canine cases.

Several patients were found with impacted canines (n=82). The total number of impacted canines was 110 with a prevalence of 2.4%. Different studies reported similar results regarding the incidence of maxillary canine impaction [2,9]. In the current study, the impacted canines were found to be higher in males (56.1%) than females (43.9%). Although this suggests a potential gender difference, statistical analysis did not reveal a significant association. It has been reported that females showed a higher incidence of impacted canines than males [8,9]. The disagreement with the results could be an outcome of including more male patients in our study. Interestingly, a significant gender difference emerged when we looked at root resorption. Males with impacted maxillary canines exhibited a higher rate of root resorption compared to females (p=0.01). Most of the current studies showed a higher incidence of toot resorption in females [7,8]. Another study showed no relationship between gender and the prevalence of root resorption in cases with impacted maxillary canines [10]. Our higher proportion of male participants might explain this discrepancy. The root resorption can occur in both genders; however, in our sample, males exhibited a higher rate of root resorption than females.

Lateral incisors are in close proximity to canines. In our samples, the most affected teeth were lateral incisors (89.5%). Nagani et al. (2021) evaluated the effect of impacted maxillary canines on the roots of the adjacent teeth. They also found that the lateral incisors were the most affected teeth with root resorption (62.5%)[3]. Another study reported that the maxillary lateral incisors are most commonly affected with root resorption (55.7%) in cases with impacted maxillary canines[7]. This highlights the crucial need to carefully assess lateral incisors for resorption in every case with impacted maxillary canines.

Our study aimed to investigate the relationship between the location of impacted maxillary canines and the degree of root resorption in adjacent teeth. While our findings indicated a higher prevalence of root resorption in sectors 1 and 2 (79%), previous research has presented mixed results. Rafflenbeul et al. (2019) similarly identified sectors 1-3 as hotspots for root resorption with the tendency of lower incidences in sectors 4 and 5 [8]. However, other studies showed that the more severe the displacement, the higher the incidence of root resorption [8,9]. Despite the inconsistencies, our study underlines the importance of meticulously evaluating all impacted maxillary canines for potential root resorption, regardless of their location, to ensure optimal patient care.

While panoramic radiographs offered a convenient screening tool in our study, they may not always give the full picture. Their two-dimensional limitations highlight the potential for underestimating the true extent of resorption. For more accurate assessment, especially in complex cases, advanced imaging techniques like Cone Beam Computed Tomography (CBCT) can provide detailed three-dimensional views, leading to more reliable results.

CONCLUSION

This study aimed to quantify the occurrence of root resorption in patients with impacted maxillary canines, revealing a significant gender difference. Male participants showed a statistically higher incidence of root resorption compared to females. Additionally, the location of the impacted canine emerged as a crucial factor, with canines located in sectors 1 and 2 demonstrating the highest correlation with adjacent tooth resorption.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Ebrahim S Alshawy, Waleed Khalid Alharbi
Drafting or Revising Critically:	Ebrahim S Alshawy, Waleed Khalid Alharbi
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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