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Research Paper: Early a radiographic evaluation of permanent maxillary canine impaction: in 7-13 years old children In Ardabil

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ABSTRACT

Introduction: Early diagnosis and interceptive treatment of the maxillary canine impaction is crucial as it reduces treatment complexity and decreases complications and adverse outcomes. The aim of the study was to the prediction of impacted maxillary canines, and early diagnosis by using panoramic.

Materials and Methods: This investigation was a cross-sectional study performed on 385 panoramic radiographs, which were evaluated to assess the position of canines. Two methods Ericson and Kurol (EK/L) and the Power and Short (PS) geometric measurement analyses used in each radiograph. Thus, the prevalence was calculated from each method. The normality of the data was subsequently analyzed by application of a one-sample non-parametric Kolmogorov-Smirnov test. Thereafter, Fisher's exact and Mann-Whitney U tests were conducted to determine differences in the permanent tooth impaction of the subjects.

Results: Five permanent canines were classified as high risk through the EK/L method. While the PS method was used, 20 high risks of impaction were found. The statistical difference is detected between the right and left sides. It was found statistical difference detected between EK/L and Ps methods ($p = 0.004$).

Conclusion: The EK/L method determined a canine impaction prevalence on pa¬noramic radiographs of 1.3%, while in the PS Method, the prevalence was 5. 2%. In addition, a significant predilection of canine impaction to the gender was not found.

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Introduction

An impacted tooth is described as a situation that a fully developed tooth fails to erupt and stays lodged within either soft or hard tissue. Maxillary canines are the most common impacted tooth, following the third molar teeth (1, 2). The long eruption pathway and long development time make it one of the last teeth to erupt. The incidence of the maxillary canine's impaction ranges from 1.38% to 7.1%(3-5).

The impaction of permanent canines in the maxilla can lead to complications such as displacement and resorption of adjacent tooth roots as well as cystic changes, ankylosis or infection (6). Various theories have been proposed as to the etiology of impaction of the upper canine. The role of heredity is indicated by the combination of other dental abnormalities, frequent bilateral occurrence, differential incidence between genders or race/ethnicity, and frequent familial occurrence. Lack of space in the maxillary arch is often associated with canine impaction(7, 8). On the other hand, the local contributing factors that cause canine impaction include the retained deciduous canine or failure of resorption of the primary canine root, and early loss of the deciduous canine(9).

Early diagnosis is important, and interactive management of canine maxillary impaction is essential as it reduces treatment cost and time, reduces the risk of complications or side effects, and leads to esthetic and functional outcomes (10).

A tooth impaction is often diagnosed during a routine dental exam by a pediatric dentist, orthodontist, or general dentist. Even if the eruption of the upper canines is normal, regular check-ups are necessary (11). Palpation of the canine bulge in the buccal sulcus from 10 to 11 years is a well-established method for identifying canine impaction. Panoramic images have also been described as a valuable early prediction tool (12, 13). However, since the magnifications on the panoramic radiographs varied depending on factors such as the patient's head position, panoramic radiographs have been used to determine the relative, and not the absolute, position of the maxillary canine with respect to other structures(10, 14).

However, numerous authors have suggested various parameters for distinction of canine impaction. The Ericson and Kurol and the Power and Short methods are the most popular analyses employed for these purposes(15).

Given this, the study is aimed at determining a prediction risk of impaction by using both the Ericson and Kurol [modified by Lindauer et al.] and the Power and Short measurement analyses on panoramic radiographs for the prediction of maxillary canine impaction.

Material and Methods

This cross-sectional descriptive study was conducted according to the regulations of the Ethics Committee (IR.ARUMS.REC.1401.028) of the Faculty of Dentistry, Ardabil University of Medical Sciences. In this study, in addition to recording information such as age and gender, panoramic radiographs of 7-13-year-old patients who were referred to a specific radiology center from March 2021 to September 2022 were used. 847 panoramic radiographs were evaluated, of which 385 radiographs (770 canine) met the inclusion and exclusion criteria of this study. The study inclusion criteria include non-syndromic patients, with no history of orthodontic treatment, with unerupted permanent canines and fully erupted upper incisors. Exclusion criteria include severe crowding of maxillary anterior teeth, absence of permanent lateral incisors, development of less than one third of maxillary permanent canine root, presence of bone pathologies such as granuloma, cyst and odontoma. To do this study of two methods Ericson and Kurol (EK/L) and the Power and Short (PS) geometric measurement analyses used in each radiograph. In EK/L method of three distal, central and mesial lines on stretched tangentially with the root and crown of the adjacent lateral tooth and four areas are created:

I: an area distal to the distal line

II: an area between the distal line and the central line

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III: an area between the central line and the mesial line

IV: including the III area and all the areas after that (Figure1)

The mesiodistal situation of the maxillary permanent canine is classified into 4 grades according to the part where the tip of the canine cusp tip is located:

PMC-I and PMC-II: low risk of impaction

PMC-III and PMC-IV: high risk of impaction

In PS grading, a vertical line was drawn from the internasal suture, intermaxillary suture, nasal septum and anterior nasal spine. Then a line perpendicular to that line was drawn as a horizontal reference plane. The angle formed between the vertical axis of the unerupted canine and the first line was measured and the result were reported as follows:

Angle between 0-30°: low risk of impaction

Angle greater than 31°: high risk of impaction (Figure2)

Digimizer v5.4.9 software was used to draw the lines and to achieve the required angles. Each percentage of the high risk of impaction in both methods is considered as the prevalent of the probability of impaction of the permanent maxillary canine. Fishers exact and Mann-Whitney U tests were used to analyze the data. The data were entered into SPSS v.21 software for analysis.

Results

From the total 385 patients included in the study, 160 were males (41.6%) and 225 were females (58.4%). The age range of the patients was 9.07±1.2 years.

Five permanent canine (1.3%) were classified as high risk through the EK/L method (0/38% in females and 0.28% in males). While the PS method was used, 20 (5. 2%) high risk of impaction were found (1.68% in females and 0.9% in males). In both methods, the right side exhibited a low prevalence of tooth impactions (Table 1). When the right (p=0.741) and left (p=0.570) prevalence were compared with gender, no statistical difference could be detected between them. When both prevalences were compared, statistical difference could be detected between them (p = 0.004).

Discussion

The movements of the erupting maxillary canines are unique and eruption disturbances can be partly explained by their long path and lengthy development period(1). At an age of 9–10 years, the permanent maxillary canines should be clinically palpable, making this a critical age, since a dentist can predict the path of maxillary canine eruption by clinical palpation (16). However, Early diagnosis and interceptive treatment of the maxillary canine eruption disturbances is crucial as it reduces treatment complexity and decreases complications and adverse outcomes. Mavreas and Athanasiou (17) reported that increased age and severity of canine impaction affect the complexity of orthodontic treatment. Three-dimensional analysis with cone beam computed tomography (CBCT) is much more accurate for determining the exact position of canine teeth(18). But this image is not usually prescribed for routine examinations due to the high cost. Various studies had been done to diagnose impacted canines early through panoramic radiographs and showed a notable degree of success.

The EK/L method, also called the “sector method”, classifies the probability of canine impact by the sector in which the canine cusp tip was located (15). Warford found the greatest probability of impaction was grade of III and IV of EK/L(19). According to Lövgren results, sector location, angulation to the midline, and vertical level to the occlusal plane are indicators of impaction, yielding good predictive power(20).

In the present study 1.3% of canines were in sectors III, and IV by EK/L method and 5. 2% of canine had an angle greater than 31 degrees and were classified as high risk. Similar to this findings, the prevalence of maxillary canine impaction was 1.2% in Iranian population

according to the results reported by Haghanifar (21).

Al-Motareb reported the prevalence of canine impaction is a common dental anomaly and observed in 3.55% of Yemeni population with age more than 15(22). In a study by Dalili in Rasht the prevalence of impaction was 4.34%, which is inconsistent with our findings(23).

Altaee(24) and Sridharan(25) found a higher frequency for maxillary canine impaction. These differences may be due to the difference in the race and the age of the sample of the previously mentioned studies. Also the prevalence of impaction seems to increase with age(23), smaller arch width due to the extraction of primary teeth or other local factors in the elderly may contribute to this process.

Shin (11) compare the normal eruption pattern and angulation in impacted maxillary canines using panoramic radiographs to predict maxillary canine impaction. They reported that the normal eruption pathway of maxillary canines can be determined in accordance with the location of the lateral incisors. Shin considered inclination was 0° when the long axis of the canine was parallel to that of the lateral incisor. The range of inclination founded in normally erupted canines was between −10° and −30°. Alejos (15) evaluated the two radiographic methods used here and found high statistical agreement between them. In this present was significantly difference between two method and PS method showed a higher probability that the canine was impacted.

We observe that both the canine angulation and position in left side indicate high impaction probility. Previous studies have also shown that upper right canines are less affected than left canines (8, 26). This agrees with the studies by Aqeel about impacted maxillary canine who reported also a higher prevalence on the left side 57.1% while it was only 37.2% on the right side. A study on Turkish population carried out by Topkara and Sari (27) found that the left and right distribution of impacted maxillary canine was 52.5% and 47.5% respectively. In contrast with those by some authors that we did not find any statistically significant differences by gender. According to the study by Guarnieri (26, 28) was positively associated with the canine impaction and the female sex.

These discrepancies can be explained by the significant heterogeneity in age, ethnicity, inclusion criteria and methods of measurement.

However, the accuracy of prediction is limited because panoramic ra¬diographs are two-dimensional images, the accurate diagnosis of a canine impaction relies on a combination of careful clinical and exhaustive radiographic assessments in the panoramic image. The periodic panoramic radiographic observations and preventive treatment are needed for canine eruption that demonstrates a deviation from the normal pathway. When the relative location and crown inclination of the canine are not within the normal eruption range, impaction can occur, and the canine should be carefully observed.

There is a low risk of impaction of maxillary canines in the Ardabil population. However, more cohort studies using more radiographic and clinical indicators need to be done to confirm the risk of impaction further.

Conclusions

The EK/L method determined a canine impaction prevalence on pa¬noramic radiographs of 1.3%, while in the PS Method the prevalence was 5. 2%. In addition, a significant predilection of canine impaction to the gender was not found.

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Considering that only the radiographs available in the Oral and maxillofacial radiology center were used in this article, there is no ethical issues. The code of ethics related to the thesis is IR.ARUMS.REC.1401.028

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