Original Article

Radiographic Assessment of the Prevalence and Pattern of Impacted Canines: A Cross-sectional Retrospective Radiographic Study

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Abstract

Background: Maxillary impacted canines are a common problem that requires a diagnosis and treatment plan in the dental clinic. **Objectives:** The present study aimed to determine the prevalence and pattern of impaction for maxillary permanent canines using the seven-subtype classification system. **Materials and Methods:** This retrospective, cross-sectional, and descriptive study was conducted using the radiographic data of residents aged 14 years or older in Karbala City/Iraq. The panoramic radiographs (OPGs) of 2840 patients were screened for the presence of impacted upper canines, and the occurrence of every subtype of impaction was also assessed. **Results:** The results indicated that among the 2840 screened OPGs, maxillary impacted canines were identified in 187 patients (6.58%), with a total of 244 impacted canines; 69.52% were associated with unilateral impaction; and 30.48% were associated with bilateral impaction. The female patients showed a higher percentage (59.89%) of impacted canines than male patients (40.11%). The percentage of OPGs associated with another impaction other than upper canines was (27.80%). Most cases of impacted upper canines were seen within the age group of ≤ 20 years (60.97%) and on the left side (52.04%). The majority of maxillary impacted canines belonged to Type II of the classification of impacted canines, followed by Types I, IV&V, VII, III, and VI. **Conclusion:** The prevalence of maxillary canine impaction was 6.58%. Factors such as unilateral impaction, female gender, and the left side suggested higher percentages of impaction. Most of the cases of impacted upper canines were seen within the age group of ≤20 years. The type II pattern of maxillary canine impaction was the commonest. OPG can be used for early diagnosis of maxillary impacted canines, and this is important for the success of the treatment.

Keywords: Canine, impaction, OPG, prevalence

Introduction

After the third molars, the maxillary impacted canines are the most commonly impacted teeth and affect about 2% of the population and mostly occurring in a young adults and are seen less commonly in males than in females.[1] Maxillary impacted canines are twice as likely to occur as the mandible impacted canines, and about 8% of patients affected by maxillary impacted canines have bilateral canine impaction.[2] The main causes of canine impaction are genetic, localized factors like supernumerary teeth or may be due to systemic causes.[3] Canine impactions are sometimes seen in patients with malnutrition, rickets, cleft lip and palate, and certain syndromes such as Downs syndrome, cleidocranial dysplasia, and achondrodysplasia.[4] Racially, it was found that the Caucasian population has five times more permanent canine impaction than the Asian population.[5]

Canines play an important role in the appropriate facial appearance and functional occlusion. It was established that extraction of the deciduous canine before the age of 11 years may adjust the eruption position of permanent

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canines in most of the cases,[6] and for this reason, the orthodontists may propose different technical treatments to recover the impacted canines,[7] and this depends on the degree of impaction, which affects the success of early treatment and the patient's age.[8]

The localization of the position of the maxillary impacted canines depends on the clinical and radiographic examination. Clinically, delayed eruption of the permanent canine after the age of 14 or 15 years, the presence of a palatal bulge, and displacement of the lateral incisor may be observed. But the radiographical images can enable the proper localization of the impacted maxillary canines, which can help determine the extent of tooth displacement and determine the type of treatment, whether by orthodontic or surgical approach.[9]

The most effective treatment approach depends on the early diagnosis of impacted canines in growing individuals. Panoramic radiograph (OPG) is the most standard screening tool used by dental specialists.[10] Early diagnosis of canine impaction on OPG is important for dentists; it can facilitate treatment plane, assess the region for surgical approach and direction of orthodontic force application, as well as determine the appropriate time for the needed treatment.[11] The aim of this research was to determine the prevalence and pattern of impacted upper permanent canines in Karbala/ Iraqi Population using orthopantomograms.

Materials and Methods

In this cross-sectional retrospective study, a total of 2840 OPGs were included in the research. The OPGs were taken routinely for pretreatment diagnostic purposes in patients attending different dental clinics from a period between July 2021 and May 2023. All OPGs had been taken using an extra-oral digital Kodak 9000 imaging system with an exposure time of 12.5s, a current of 12 mA, and a voltage of 73 kV. The study design was approved by the Al-Safwa University College Ethics Committee. The inclusion criteria are dentulous patients with permanent dentition within the age of 14 years and above, with the presence of upper permanent impacted maxillary canines which are not likely to erupt. The exclusion criteria are patients who have undergone surgical extraction of maxillary canine, with jaw fracture or pathological lesions related to the canine area, cleft lip and palate, patients with syndromes like Down syndrome, or distorted OPGs with poor visibility in the canine area.

From a total of 2840 screened OPG images, 187 individuals with maxillary impacted canines fulfilled the inclusion criteria. The gender of the patients, age, side of impaction, and the association with another impaction were recorded. The OPGs of these patients were categorized according to the classification system for maxillary impacted canines proposed by Yamamoto *et al.*[12,13]

The statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS) version 23.0 (SPSS, IBM Company, Chicago, IL 60606, USA) to assess the prevalence and pattern of maxillary canine impaction in a population of Karbala, Iraq. All the data were collected and tabulated in Excel program

Results

Among the 2840 screened OPGs, maxillary impacted canines were identified in 187(6.58%) patients [Table 1], with a total of 244 impacted canines, 130 OPGs (69.52%) associated with unilateral impaction (31.55% for males and 37.97% for females), while 57 OPGs (30.48%) were associated with bilateral impaction (8.56% for males and 21.94% for females), and the females showed a higher percentage (59.89%) of impacted canines than males (40.11%), as seen in Table 2.

The age range of the patients was from 14 to 58 years. Figure 1 shows a 58-year-old patient with impacted upper canines. The number of OPGs associated with upper canine impaction only was 135 (72.20%), while the number of OPGs which were associated with another impaction other than upper canines was 52(27.80%), and most of the cases of impacted canines were seen within the age group ≤20 years (60.97%), followed by the age group 21–30 years (22.45%), as seen in Table 3.

The total percentage of impacted canines was 36.47% for type I, 54.5% for type II, 0.83% for type III, 4.1% for type IV/V, 0% for type VI, and 4.1% for type VII.

The total number of right impacted canines was 117 teeth, 45(18.44%) for type I, 62(25.41%) for type II, 2(0.83%) for

Table 1: The number and percentage of patients with or without maxillary impacted canines in the studied population in each gender

Gender	Criteria						Total (No.&%)
Male	No impaction	Number	942	With impaction	Number	75	1017 35.81%
		Percentage	33.17%		Percentage	2.64%	
Female	No impaction	Number	1711	With impaction	Number	112	1823 64.19%
		Percentage	60.25%		Percentage	3.94%	
Total (No.&%)	2653 93.42%			187 6.58%			2840 100%

Table 2: The number and percentage of unilateral and bilateral impaction in patients with maxillary impacted canines in the studied population by gender

Gender	Criteria						Total (No.&%)
Male	Unilateral impaction	Number	59	Bilateral impaction	Number	16	75 40.11%
		Percentage	31.55%		Percentage	8.56%	
Female	Unilateral impaction	Number	71	Bilateral impaction	Number	41	112 59.89%
		Percentage	37.97%		Percentage	21.94%	
Total (No.&%)	130 69.52%			57 30.48%			187 100%

Table 3: Distribution according to the age group of the patients in relation with or without the association with another impacted tooth

Age group	Maxillary impacted canine only		Associated with another impaction		Total number of patients with maxillary impacted canines	
	No.	%	No.	%	No.	%
≤ 20	79	42.25%	35	18.71%	114	60.97%
21–30	27	14.44%	15	8.02%	42	22.45%
31–40	12	6.42%	2	1.07%	14	7.49%
41–50	9	4.81%	0	0%	9	4.81%
>50	8	4.28%	0	0%	8	4.28%
Total	135	72.20%	52	27.80%	187	100%

Table 4: The number and percentage of impaction according to the classification system for maxillary impacted canines in each gender

Side	Gender	I	II	III	IV/V	VI	VII	Total (No.&%)
Right maxillary impacted canine	Male	14	23	1	3	0	2	43 36.75%
	Female	31	39	1	2	0	1	74 63.25%
	Total (No.&%)	45 18.44%	62 25.41%	2 0.83%	5 2.05%	0 0%	3 1.23%	117 47.96%
Left maxillary impacted canine	Male	18	27	0	2	0	2	49
	Female	26	44	0	3	0	5	78
	Total (No.&%)	44 18.03%	71 29.09%	0 0%	5 2.05%	0 0%	7 2.87%	127 52.04%
Total		89 36.47%	133 54.50%	2 0.83%	10 4.1%	0 0%	10 4.1%	244 100%

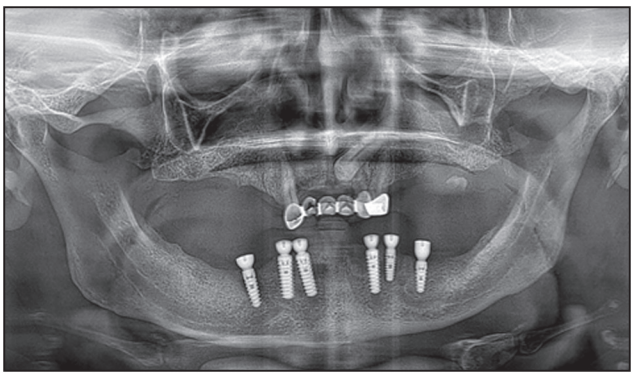

Figure 1: OPG of a 58-year-old male patient with an impacted maxillary left canine

type III, 5(2.05%) for type IV and V, 0 (0%) for type VI, and 3(1.23%) for type VII.

The total number of left impacted canines was higher than that of the right side (127 teeth, 52.04%), 44(18.03%) for type I, 71(29.09%) for type II, 0(0%) for type III, 5(2.05%) for types IV and V, 0 (0%) for type VI, and 7(2.87%) for type VII [Table 4]. Figures 2 and 3 show different classification systems for maxillary impacted canines.

Discussion

Canines are playing an essential role in arch development, support of facial appearance, functional occlusion, and

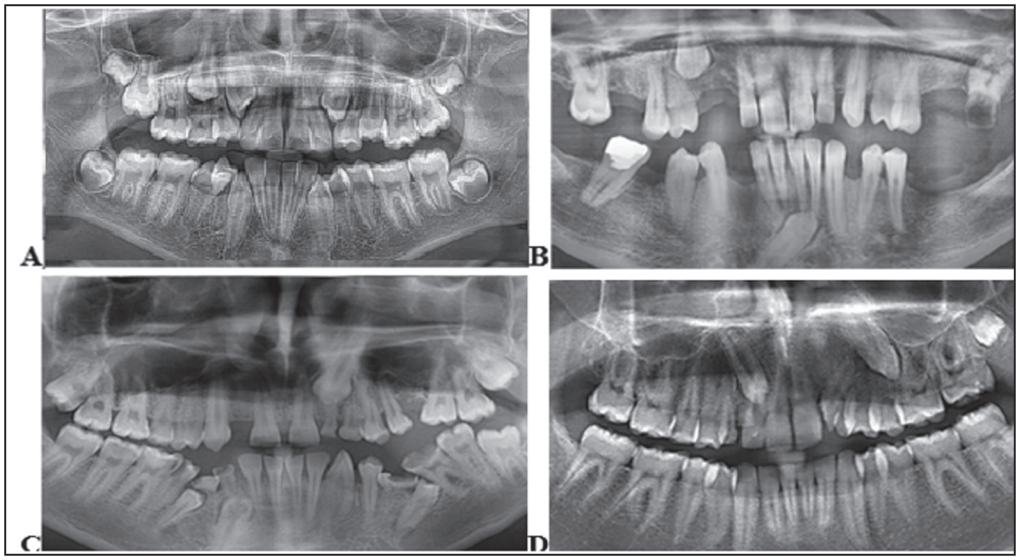

Figure 2: Middle segment of an orthopantomogram showing (A) bilateral vertically impacted upper canines and (B) right upper impacted canine, with the tooth axis being almost perpendicular to the occlusal plane. (C) Impacted upper left canine inclined mesially against the occlusal plane. (D) The left impacted canines inclined distally against the occlusal plane, while the right inclined mesially

Table 5: The prevalence of maxillary canine impaction in different countries

Country		Incidence		Country	Incidence
1	North Greek[16]	8.4%	7	Kosovo[17]	1.62%
2	Sweden[18]	2.2%	8	Hungary[19]	5.4%
3	North Indian[20]	9.7%	9	Saudi Arabia[21]	3.46%
4	Cyprus[22]	3.53%	10	China[23]	1%
5	Egypt[24]	5.28%	11	Japan[25]	0.27%
6	Turkey[26]	5.1%	12	Italia[27]	4%

Table 6: Percentage of maxillary canine impaction for each gender in different countries

Country	Male	Female
Japan[12]	32.86%	67.14%
Egypt[24]	35.1%	64.9%
Saudi Arabia[21]	41.62%	58.38%
Belgium[28]	36.92%	63.08%
Turkey[29]	33.11%	66.89%
Iraq/ Najaf[30]	37%	63%

dental aesthetic and must be diagnosed and treated as soon as possible to avoid any severe complications.[14] OPG is a two-dimensional image which represents a broad anatomical area in a fast, inexpensive, and with minimal hazard to the patients and can be used to evaluate the impacted teeth.

In the present study, the prevalence of maxillary canine impaction was 6.58%. It is different from that of other countries because the canines are seen to involve a major genetic component[15] and vary among various ethnic and racial populations, as seen in Table 5.

Regarding the gender, 75 patients were male (35.81%), and 112 were female (64.19%). This comes in agreement with the results of other studies [Table 6], in which they suggested also that the canine impaction was more common among women than men. This may be attributed to the fact that the maxilla is smaller in women than in men.[31] These results disagree with other results, in which they found a higher prevalence of maxillary impacted canines in males (n = 74, 55.22%) compared to females (n = 60, 44.78%).[32]

In the present study, most of our patients were within the age group ≤ 20 years and 27.80% had impacted maxillary canines, which were associated with other impacted teeth. Grisar *et al*.[28] found that most of the patients were 19 years or younger (82.3%). Alhammadi *et al*.[33] found that 92.5% had impacted maxillary canines only, and 7.5% had impacted maxillary canines, with other impacted teeth.

The present study also showed that bilateral maxillary canine impaction was present in 30.48% of the patients, and the left side is affected more than the right side. Alhammadi *et al.*[33] found that only 2.3% of the patients showed bilateral impaction. Gashi *et al*.[17] found 24.43%

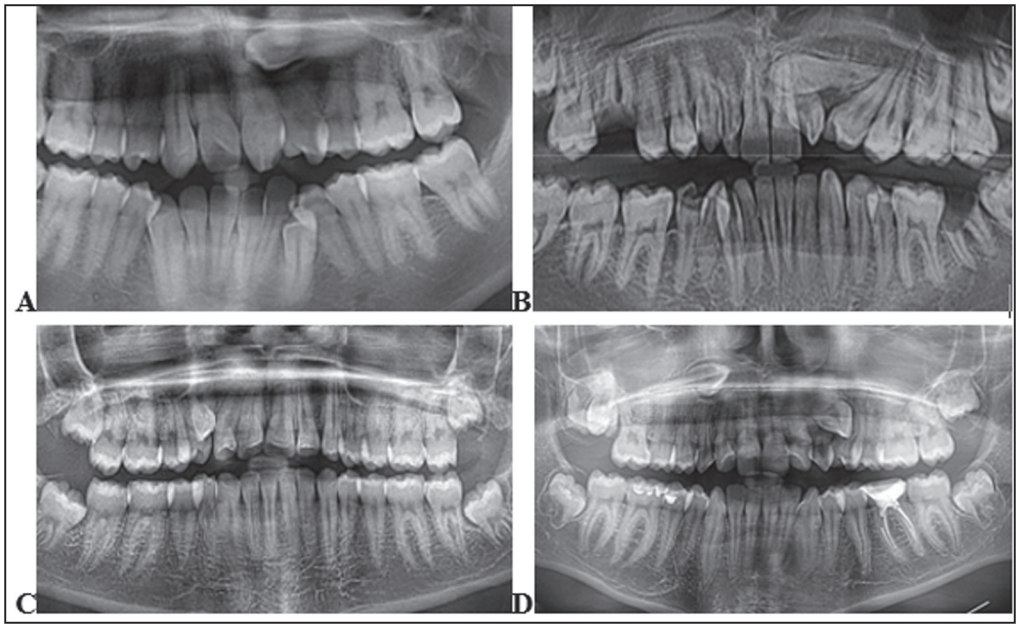

Figure 3: Middle segment of an orthopantomogram showing (A,B) a horizontally impacted upper canine, with the crown directed mesially. (C,D) Labio-palatal impaction

of the cases had bilateral impactions. The research by Alassiry[21] found a higher prevalence of maxillary impacted canines on the left side (52%) than on the right side (48%), which is similar to that found by Takahama *et al*.[25] and Al-Zoubi *et al*.[34] There is no scientific evidence to justify this predominant occurrence on the left side.

According to the classification system for maxillary impacted canines, the present study showed that the frequency of Type II maxillary impacted canines was (55.92%), followed by Type I (34.63%). The study by Al-Zoubi *et al.*[34] revealed that Type I constitute (12.5%), Type II (51.6%), Type III (4.8%), Type IV (28.2%), Type V (0%), Type VI 0.6%, and Type VII 2.3%. According to Miller's theory,[35] the canine's development has a more mesial path, which is guided downward along the distal aspect of the root of the lateral incisor. In contrast, Alassiry[26] found that 46% of the cases had Type I, 37% had Type II, 8% had Type VI, 3% had Types III, V, and VII, and 0% Type IV canine impaction.

There are several factors contributing to the impaction of maxillary canines like the late maxillary canine tooth germ development and its long eruption path, increasing the bone density and pressure from surrounding bony cavities, such as the nasal wall and orbital cavities and maxillary sinus can cause unfavorable impaction of the canine.[36]

Conclusion

Maxillary impacted canines can be diagnosed using panoramic imaging. Among the 2840 screened OPGs, maxillary impacted canines were identified in 6.5% patients, with a total of 244 impacted canines; 130 OPGs (69.52%) were associated with unilateral impaction; and 30.48% were associated with bilateral impaction. The females showed a higher number and percentage of impacted canines than males. The number of OPGs associated with maxillary canine impaction was 135 (72.20%), while the number of OPGs associated with another impaction other than upper canines was 52 (27.80%), and most of the cases of impacted canines were seen within the age group of ≤20 years.

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Conflict of interest

There are no conflicts of interest.

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