

Retrospective Evaluation of the Prevalence of Impacted Canines in Orthodontic Patients Prospective 3D Model-Based Study

Kavita Kumari Anshu¹, Shagufta Anjum²

¹Senior Resident, Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya ji, Bihar, India

²Senior Resident, Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya ji, Bihar, India

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Corresponding Author: Dr. Kavita Kumari Anshu

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Abstract:

Background: Impacted canines are an important orthodontic concern because of their prolonged eruption pathway and potential to cause displacement, root resorption, and other complications involving adjacent teeth. Their prevalence varies across populations and orthodontic patient groups.

Aim: To retrospectively evaluate the prevalence and distribution of impacted canines among orthodontic patients.

Methodology: A retrospective descriptive study was conducted in the Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya ji, Bihar. Records of 90 orthodontic patients aged ≥ 15 years with complete clinical and panoramic radiographic data were reviewed. Demographic and radiographic characteristics of impacted canines were recorded and analyzed using IBM SPSS Statistics version 27.0.

Results: Impacted canines were identified in 14 of 90 patients, giving a prevalence of 15.6%. Among affected patients, 42.9% were aged 15–18 years and 35.7% were aged 19–22 years. Females accounted for 57.1% and males for 42.9%. Maxillary impaction predominated (92.9%), while mandibular involvement was 7.1%. Unilateral impaction occurred in 85.7% and bilateral impaction in 14.3%. Among unilateral cases, left-sided impaction was more frequent (58.3%) than right-sided involvement (41.7%).

Conclusion: Impacted canines were relatively frequent among the studied orthodontic patients, with predominance in younger patients, females, the maxillary arch, and unilateral presentation. Early clinical and radiographic assessment is important for timely orthodontic management.

Keywords: Impacted Canine; Orthodontic Patients; Maxillary Canine; Tooth Impaction; Prevalence; Radiographic Assessment.

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Introduction

It is important that impacted canines are considered as a developmental and orthodontic issue due to their anatomic location in the dental arch and their significance in the functional occlusion and facial aesthetics [1]. Tooth impaction is when a permanent tooth has not erupted into the oral cavity within the appropriate time frame, despite continued growth. The second most common impaction (after third molars) is of the maxillary canine. There are a variety of genetic, ethnic, environmental and methodological differences among populations and geographic regions that affect the prevalence of impacted canines. An impacted canine is clinically significant as it can be silent but can displace or resorb other teeth.

The canine of the maxilla is an eruption pathway that is complicated and lengthy, and therefore prone to developmental disturbances [2]. Impacted canines can be palatal, labial or in the alveolar bone. Several

local causes of canine impaction have been correlated such as insufficient arch space, abnormal position of the tooth germ, long retention of deciduous canines, early loss of primary teeth, supernumerary teeth, odontomas, and other abnormalities that create an obstruction. Permanent canines may also be located and erupt due to genetic and developmental issues [3].

The prevalence of impacted canines in the general population has been reported around the world, and is thought to be around 1–3% in most studies, but there are significant differences between studies and population sizes [4]. Mandibular canine impaction is much less common than maxillary canine impaction. The prevalence reported may vary by age, sex, ethnicity, size of the study population, diagnostic techniques and sampling. Patients receiving orthodontic treatment may have a comparatively high rate, as are

the patients with malocclusion, delayed eruption, and abnormal positioning of the teeth, who are likely to receive a detailed clinical and radiographic evaluation [5].

Canines that have an impact can be linked with a couple dental issues. The abnormal position can lead to shifting, rotating, or even migrating of neighbouring teeth, and it can hinder normal dental arch development [6]. One of the most serious complications that can occur with impacted canines is external root resorption of the lateral incisor as well as the central incisor or the premolar may be involved as well. Other complications may be cyst formation, infection, periodontal issues, pain and damage to adjacent teeth. Early detection is thus crucial to reduce the risk of irreversible complications.

Physical examination can be very valuable in determining canine impaction. Eruption disturbance is suggested by delayed eruption, the presence of a deciduous canine, asymmetry of canine eruption and the absence of the permanent canine in its eruption site. Radiographic examination to accurately establish the location, angulation, depth and relationship of the involved canine to adjacent teeth and surrounding structures is critical [7]. Assessment is typically performed with panoramic and periapical radiographs, and in some cases, cone-beam computed tomography may be used to give three-dimensional information.

Treatment for impacted canines is based on patient's age, position/angulation of the tooth, arch space, root development, and relationship with adjacent teeth [8]. Observation is sometimes indicated, extraction of primary canine, orthodontic space preparation, surgical exposure plus orthodontic traction is sometimes indicated, or extraction of the impacted permanent canine when it is not possible to preserve it. If the diagnosis is early, interceptive treatment can be facilitated and the treatment may be simpler, shorter and less likely to damage adjacent teeth.

A retrospective analysis of orthodontic records is a helpful tool for estimating the prevalence and distribution of impacted canines in a specific patient population. These studies can determine the incidence of impaction and present impaction patterns by age, sex, arch, side, and/or other clinically or radiographically relevant parameters. Existing records can also be analyzed in order to determine common presentations and corresponding findings that do not require any additional intervention for patients.

The prevalence and distribution of impacted canines is reported to have varied among populations, but has been investigated extensively. Retrospective information from institutions can thus be helpful in providing information about the burden and nature of this condition in orthodontic patients. This present study is conducted to investigate the occurrence and distribution of impacted canines among

orthodontic patients in the last two decades in a retrospective study and according to the associated demographic and clinical parameters. The results can help to gain insight into the pattern of canine impaction in the area and to plan for timely diagnosis, treatment, and better orthodontic treatment of patients with impacted canines.

Methodology

Study Design: A retrospective descriptive study was conducted to evaluate the prevalence and pattern of impacted permanent canines among orthodontic patients. The study was based on previously recorded clinical and radiographic data available in the department records.

Study Area: The study was conducted in the Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya ji, Bihar, India.

Study Duration: The study was conducted over a period of one year from December 2024 to November 2025.

Study Participants: The study participants comprised orthodontic patients whose clinical records and relevant radiographic investigations were available during the study period.

Inclusion Criteria

- Orthodontic patients with available complete clinical records.
- Patients with available panoramic radiographs (orthopantomograms) of adequate diagnostic quality.
- Patients aged 15 years or above.
- Patients with radiographic evidence of an impacted permanent canine.
- Patients with no history of previous orthodontic treatment.

Exclusion Criteria

- Patients with a history of extraction of the permanent canine.
- Patients with systemic diseases or conditions affecting dental development.
- Patients with developmental anomalies or syndromes associated with abnormal tooth development.
- Patients with a history of trauma or jaw fracture that could have affected normal dentofacial development.
- Patients with incomplete or missing clinical/radiographic records.
- Radiographs with poor image quality or inadequate visualization of the canine region.

Sample Size: A total of 90 orthodontic patient records were included in the study. The records were selected according to the predefined inclusion and exclusion criteria.

Procedure: The required data were retrospectively collected from the orthodontic records maintained in the Department of Dentistry. Clinical records and available panoramic radiographs were reviewed to identify patients with impacted permanent canines. A canine was considered impacted when it had failed to erupt into the normal functional occlusal position within the expected period of eruption. The demographic characteristics, including age and sex, were recorded from the patient records. Radiographic assessment was performed using available orthopantomograms to identify the presence of canine impaction. The presence and location of impacted canines were documented, including whether the impaction involved the maxillary or mandibular arch and whether it occurred unilaterally or bilaterally. When available in the records, additional radiographic investigations such as cone-beam computed tomography were reviewed to further determine the position and localization of the impacted canine. The relevant findings were systematically entered into a structured data collection sheet. The collected information was subsequently coded, tabulated, and prepared for statistical analysis. Only records fulfilling the predefined eligibility criteria were included in the final sample of 90 patients.

Statistical Analysis: The collected data were entered, coded, and analyzed using IBM SPSS Statistics version 27.0. Descriptive statistics were used to summarize the study variables. Categorical variables such as sex, presence of impacted canine, arch

involved, and unilateral or bilateral impaction were expressed as frequencies and percentages. Continuous variables such as age were summarized using mean and standard deviation where appropriate. The prevalence of impacted canines was calculated as the proportion of orthodontic patients with documented canine impaction among the total eligible records reviewed. Appropriate statistical tests were applied to assess associations between categorical variables, and a p-value <0.05 was considered statistically significant.”

Result

Table 1 presents the distribution of orthodontic patients according to the presence or absence of impacted canines among the 90 study participants. Impacted canines were present in 14 patients, accounting for 15.6% of the study population, whereas 76 patients (84.4%) did not have impacted canines. Thus, the majority of orthodontic patients included in the study did not demonstrate canine impaction, while approximately one-sixth of the participants had an impacted canine. The findings indicate that impacted canines represented a relatively less frequent condition within the overall orthodontic patient population assessed in the present study. The total sample comprised 90 patients, representing 100% of the study population. Overall, the distribution demonstrates a clear predominance of patients without impacted canines compared with those having impacted canines.

Table 1: Distribution of orthodontic patients according to presence of impacted canine (n=90)		
Presence of impacted canine	Frequency (n)	Percentage (%)
Present	14	15.6
Absent	76	84.4
Total	90	100

Table 2 presents the age distribution of orthodontic patients according to the presence or absence of impacted canines among the 90 study participants. Among the 14 patients with impacted canines, the highest proportion belonged to the 15–18 years age group, comprising 6 cases (42.9%), followed by the 19–22 years group with 5 cases (35.7%). The 23–26 years and ≥27 years groups accounted for 2 (14.3%) and 1 (7.1%) cases, respectively. Among patients without impacted canines, the 19–22 years group

had the highest representation with 29 patients (38.2%), followed by 15–18 years with 28 patients (36.8%). In the overall study population, the 15–18 and 19–22 years age groups each comprised 34 patients (37.8%). Overall, impacted canines were predominantly observed among younger orthodontic patients, particularly those aged 15–18 years, while their frequency decreased progressively with increasing age.

Table 2: Age distribution of orthodontic patients according to presence of impacted canine (n=90)			
Age group (Years)	Impacted canine Present n (%)	Impacted canine Absent n (%)	Total n (%)
15–18	6 (42.9)	28 (36.8)	34 (37.8)
19–22	5 (35.7)	29 (38.2)	34 (37.8)
23–26	2 (14.3)	13 (17.1)	15 (16.7)
≥27	1 (7.1)	6 (7.9)	7 (7.8)
Total	14 (100.0)	76 (100.0)	90 (100.0)

Table 3 presents the gender distribution of orthodontic patients according to the presence or absence of

impacted canines among the 90 study participants. Among the 14 patients with impacted canines,

females constituted the larger proportion, with 8 cases (57.1%), whereas males accounted for 6 cases (42.9%). Among the 76 patients without impacted canines, females also represented a slightly higher proportion, comprising 40 patients (52.6%), compared with 36 males (47.4%). In the overall study population, females accounted for 48 patients (53.3%), while males constituted 42 patients (46.7%). Thus, impacted canines were more

frequently observed among female patients than male patients in the present study. The gender distribution showed a relatively greater representation of females in both the impacted and non-impacted groups. Overall, out of the 90 orthodontic patients, 14 (15.6%) had impacted canines, while 76 (84.4%) did not, with females comprising the majority of the study population.”

Table 3: Gender distribution of orthodontic patients according to presence of impacted canine (n=90)			
Gender	Impacted canine Present n (%)	Impacted canine Absent n (%)	Total n (%)
Male	6 (42.9)	36 (47.4)	42 (46.7)
Female	8 (57.1)	40 (52.6)	48 (53.3)
Total	14 (100.0)	76 (100.0)	90 (100.0)

“Table 4 presents the distribution of impacted canines according to arch and laterality among the 14 cases identified in the study. The maxillary arch was predominantly involved, accounting for 13 cases (92.9%), whereas mandibular impaction was observed in only 1 case (7.1%). Regarding laterality, unilateral impaction was considerably more common, comprising 12 cases (85.7%), while bilateral impaction was recorded in 2 cases (14.3%). Thus, the findings demonstrated a marked predominance of impacted canines in the maxillary arch and a

higher occurrence of unilateral involvement. Overall, out of the 14 impacted canine cases, the vast majority affected the maxilla, indicating that maxillary canine impaction was substantially more frequent than mandibular involvement in the present study. Similarly, most cases presented with impaction on only one side, while bilateral involvement was relatively uncommon. The total distribution accounted for all 14 cases (100%), providing an overall description of the arch involved and laterality pattern of impacted canines in the study population.

Table 4: Distribution of impacted canines according to arch and laterality (n=14)		
Characteristics	Frequency (n)	Percentage (%)
Arch involved		
Maxillary	13	92.9
Mandibular	1	7.1
Laterality		
Unilateral	12	85.7
Bilateral	2	14.3
Total	14	100

Table 5 presents the distribution of impacted canines according to the side of impaction among unilateral cases (n=12). Among the unilateral impacted canine cases, left-sided impaction was more frequently observed, accounting for 7 cases (58.3%), whereas right-sided impaction was identified in 5 cases (41.7%). Thus, the proportion of unilateral impactions was higher on the left side than on the right side, with a difference of 16.6 percentage points. The total number of unilateral cases was 12, representing 100% of the cases included in this analysis.

These findings indicate a slight predominance of left-sided canine impaction among patients presenting with unilateral involvement. The distribution suggests that impacted canines occurred on both sides with relatively similar frequency, although left-sided impaction was more common in the present study. Since this table describes only unilateral cases and does not include bilateral impactions, the findings specifically represent the side distribution among patients with single-sided canine impaction.

Table 5: Distribution of impacted canines according to side of impaction among unilateral cases (n=12)		
Side of impaction	Frequency (n)	Percentage (%)
Right side	5	41.7
Left side	7	58.3
Total unilateral cases	12	100

Discussion

The present retrospective study aimed to assess impacted canine prevalence and distribution among 90

orthodontic patients. Fourteen patients (15.6%) had impacted canines, and 76 patients (84.4%) did not have canine impaction. This prevalence was greater

than in some previous studies in orthodontic and dental patients. In a study of orthodontic patients from central India, Jain and Debbarma [9] reported that there were canine anomalies, with a prevalence of around 1.38% impacted canines. The prevalence reported by Patil et al. (2014) [10] was about 2.9% in western Indian population and 5.6% among orthodontic patients visiting a tertiary dental hospital in Kathmandu by Piya et al. (2020) [11]. In a similar fashion, Sajnani and King 2014 [12] reported on a significant orthodontic cohort with impacted maxillary canines. The higher prevalence rate in the present study might be due to differences in sample size, study population, referral criteria, diagnostic criteria and retrospective selection of orthodontic patients. Patients seen in orthodontic practices are more likely to receive comprehensive clinical and radiographic evaluation, thus raising the likelihood of unerupted and/or ectopic canines being identified. It should be noted that the prevalence of 15.6% observed in the present study must not be extrapolated to the general population since it applies only to the orthodontic population studied."

"In the present study, the age distribution showed that the maximum number of impacted canines were observed in younger patients. Of the 14 cases, 6 (42.9%) were 15-18 years old and 5 (35.7%) were 19-22 years old, for a total of 78.6% of canine cases. Only 2 (14.3%) patients were aged 23-26 years and 1 (7.1%) patient was aged ≥ 27 years. This age clustering of cases is related to the developmental age of the eruption of the permanent canines. The eruption pathway of the maxillary canines is highly irregular and long and they are among the last permanent teeth to erupt. Sajnani and King (2014) found that in their study of children and adolescents from the south of China, the majority of affected maxillary canines were found during the adolescent period. Piya et al. (2020) have also found a significant prevalence of canine impaction in younger age group of orthodontic patients. The present study may thus be influenced by the fact that this is a time when the ectopic eruption or failure of eruption and delayed eruption of canines may become clinically apparent and warrant orthodontic investigation.

The present study also revealed that there was a slight gender imbalance with more females than males in the patients who had impacted canines. There were 14 affected patients, with 8 (57.1%) being women and 6 (42.9%) men. This finding was similar to that of several of the prior studies that reported a higher incidence of canine impaction among females. Patil et al., (2014) found a greater prevalence of impacted canines in females than in males in western Indian population. In one-center study in Riyadh, Melha et al (2017) [13] reported a higher number of female cases (44) than male cases (35) among their patients with canine impaction. Piya et al. (2020) also found more females among

the orthodontic patients who were affected. The present study, however, had a relatively small female predominance and females showed a slightly higher proportion in the non-impacted group. Consequently, the present descriptive findings are not sufficient to draw a statistically significant conclusion between the two variables, gender and impaction in dogs.

The most significant result of the present study was the significant predominance of maxillary canine impaction. All 14 affected cases were of the maxillary arch (92.9%) while one case (7.1%) was of the mandibular arch. This finding matches what has been observed in previous research. Impaction of the maxillary canine was found to be significantly higher (0.93%) compared to the mandibular canine (0.37%) by Jain & Debbarma 2019 [14]. In their study, Melha et al. (2017) also noted a high prevalence of impaction of the upper canine teeth (73 cases compared to 8 lower canine impactions). Topkara and Sari (2012) [15] also found a significantly greater number of patients with maxillary canine impaction (5.24%) than of patients with mandibular canine impaction (0.92%) in their retrospective study of orthodontic patients. The long and tortuous eruption pathway of the max cuspid, late eruption of the max cuspid in the dental arch and its close anatomical relationship with other teeth and structures in the dental arch may explain the observed maxillary predominance in the present study. The maxillary canine is especially prone to disturbances along its normal eruption path because of these factors."

"The current study also found a higher rate of unilateral impaction than bilateral impaction. Unilateral canine impaction was seen in 12 patients (85.7%) and bilateral in 2 (14.3%). The results were very similar to those of Sajnani and King (2014), who described unilateral maxillary canine impaction in 442 of 533 patients (82.9%), and bilateral impaction in 91 patients (17.1%). A high unilateral canine impaction prevalence was also reported by Patil et al. (2014). Piya et al. (2020) also observed that unilateral involvement of teeth was more common than unilateral involvement in their orthodontic patients. The fact that these studies consistently show unilateral overrepresentation in the incidences of eruption disturbance implies that most disturbances of eruption are unilateral and not simultaneous on both sides of the dental arches.

In the present study, 12 unilateral cases were found, in which 7 patients (58.3%) had the left side and 5 patients (41.7%) had the right side. So, a slight numerical preponderance of impaction on the left was found. This result is similar to those reported in a few Indian orthodontic studies where the left maxillary canine tooth has been observed to be a frequently affected tooth. Patil et al. (2014) found an increase in the percentage of left impacted canines.

The relatively small difference between the left and right side in the present study should be interpreted with caution, however. The difference may be the result of sampling variation and not a true biological preference for the left side of the body, as there were only 12 unilateral cases. Other similar right and left sided involvement has been reported in an orthodontic population by Topkara and Sari (2012).

The findings regarding the location and distribution of impacted canines are clinically relevant because accurate identification of an unerupted canine is essential for appropriate orthodontic treatment planning. Manne et al. (2012) [16] emphasized that impacted canines represent an important orthodontic challenge because their position, angulation, and relationship with adjacent structures influence diagnosis and management. Grisar et al. (2019) [17] also highlighted the importance of three-dimensional assessment of impacted maxillary canines because their position may be associated with adjacent dental pathology and can influence the selection of an appropriate treatment approach. Therefore, the high proportion of maxillary and unilateral impactions observed in the present study reinforces the importance of careful clinical examination followed by appropriate radiographic evaluation in patients with delayed or abnormal canine eruption.

The present study demonstrated that impacted canines occurred in 15.6% of the studied orthodontic patients and were predominantly observed among younger individuals, females, and patients with maxillary involvement. Maxillary impaction accounted for 92.9%, while unilateral impaction accounted for 85.7% of affected patients. The left side represented 58.3% of unilateral cases. The maxillary and unilateral predominance observed in the present study was broadly consistent with previous Indian and international studies, although the overall prevalence was higher than that reported by most comparable investigations. Differences in sample size, population characteristics, age distribution, geographic and ethnic background, referral patterns, diagnostic methods, and study design may explain these variations. The retrospective design, single-centre setting, and relatively small number of impacted cases should also be considered when interpreting the findings. Nevertheless, the present results emphasize the importance of early recognition and radiographic assessment of abnormal canine eruption, particularly during adolescence, to facilitate timely diagnosis and appropriate orthodontic management."

Conclusion

The present retrospective study evaluated the prevalence and distribution of impacted canines among 90 orthodontic patients at the Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya. Impacted canines were identified in

14 patients, giving an overall prevalence of 15.6%. The condition was predominantly observed among younger patients, particularly those aged 15–18 years, with a slight female predominance. Maxillary involvement was markedly higher than mandibular involvement, accounting for 92.9% of cases. Unilateral impaction was substantially more common than bilateral impaction, comprising 85.7% of affected patients, while left-sided involvement was slightly more frequent among unilateral cases. Overall, the findings highlight the importance of early clinical and radiographic identification of abnormal canine eruption, particularly during adolescence, to facilitate timely diagnosis, appropriate orthodontic treatment planning, and prevention of complications involving adjacent teeth.

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