Frequency and pattern of impacted Canines in Al-Madinah, Saudi Arabia: A cross-sectional radiographic study

Asim Abdulrahman Almarhoumi, Yazan A. Okashah¹, Mohammed A. Alrehaili¹ and Khalid N. Alrehaili¹

Abstract

OBJECTIVES: Impacted canine (IC) is a dental anomaly that varies in its frequency according to the population of interest. The aim of this study is to investigate the frequency and distribution pattern of maxillary ICs (MxIC) and mandibular ICs (MnIC) in the population of Al-Madinah, Saudi Arabia.

MATERIALS AND METHODS: A cross-sectional retrospective study of all patients attended Taibah University Dental Hospital, Madinah, Saudi Arabia. Inclusion criteria were individuals aged 15 years and older and no history of orthodontic treatment or craniofacial syndromes. Patients with incomplete dental records or missing/distorted Orthopantomograph (OPG) were excluded. All OPGs were taken using standardized equipment. Data were explored for frequency and pattern of canine impaction both in the maxilla and the mandible and statistically tested to detect significant differences.

RESULTS: A total of 7466 individuals fulfilled the inclusion criteria with mean age of 37.43 ± 14.5 years. Of the total sample, 173 individuals had at least one IC. MxIC alone occurred in 86.71% of the cases, while MnIC occurred in 8.67%. The remaining 4.62% had at least one IC in each jaw. Unilateral IC occurred in 89.2% of the cases with left-side predominance in the maxilla.

CONCLUSION: In this sample, the frequency of MxIC was 2.1% and MnIC was 0.3%. Almost equal distribution of IC occurred between females and males (IC Odds ratio F:M 1:1.08). Further studies are required to investigate the potential association of IC incidence with other predictor variables.

Keywords: Canine impaction, frequency, orthodontics, prevalence, Saudi Arabia

Introduction

Tooth eruption is controlled by complex multifactorial genetic and environmental interaction. Hence, aberrations in tooth eruption process such as early, delayed, or failure of eruption can occur.¹ Tooth impaction is one of the most common dental anomalies. When a tooth fails to erupt at the appropriate developmental timing due to physical barrier, it is considered as an impacted tooth.² Maxillary canine (cuspid) is the tooth most prone to impaction following third molars.³ Canines have an important role in the esthetics, function, and occlusion protection.⁴ The sequelae of impacted canines (ICs) include ectopic position and transmigration, dentigerous cyst formation, internal and external root resorption of the impacted canine or the adjacent teeth, and loss of arch length and facial alar support.⁵ Therefore, it could be argued that canine impaction could have detrimental influence on the stomatognathic system.

Several local and systemic factors could lead to the etiology of canine impaction such as crowding, congenital syndromes, and lateral incisors anomalies.⁶ Some of the impaction
Canine impaction is usually asymptomatic, so it is often diagnosed by coincidence during routine check-ups or for any other dental reasons. For evaluation of the presence, position, and pathology related to the IC, different radiographic modalities are utilized such as intra-oral periapical radiographs, occlusal radiographs, orthopantomograms (OPG), cone beam computed tomography, and computed tomography.\(^8\)

According to the literature, the prevalence of IC ranged from 0.8% to 8% based on the populations or ethnicities studied.\(^9\) This wide range necessitates studying and reporting the frequency of IC for each population specifically for better demographic understanding and effective local health-resource allocation and management. In Saudi Arabia, reports of IC prevalence varied according to geographic regions and the population within. It ranged from as little as 1.44% to 10.1%.\(^12\)\(^13\) This wide range is attributed to the sampling size, characteristics, and methodologies used for IC detection. Nevertheless, data still lacking regarding maxillary and mandibular ICs (MxIC and MnIC) frequencies from other geographic parts including this region where the study was conducted. Exploration of IC frequency specifically for this region would not only just be beneficial for better local health-resource allocation within the region but also to plot the findings of this study against previously reported frequencies in Saudi Arabia in order to reduce the wide-range bias of IC within the country.

Therefore, the aim for this study is to investigate the frequency and distribution pattern of MxIC and MnIC according to sex in the population of Al-Madinah Region, Saudi Arabia.

Materials and Methods

A cross-sectional retrospective radiographic study was carried out to assess the frequency of MxIC and MnIC in a hospital-based setting in Al-Madinah, Saudi Arabia.

Ethical approval was granted from the relevant institution. The study has been conducted in accordance with the ethical principles mentioned in the Declaration of Helsinki (2013). OPG images of all patients from January 2014 to December 2018 were evaluated. Inclusion criteria were patients who are 15 years old and above and patients with no previous history of orthodontic treatment and no craniofacial syndromes. Exclusion criteria were poor quality and distorted OPGs, patients who had previous orthodontic therapy, and patients with history of lateral incisor or premolars extraction to minimize the possibility of selection bias.

Pattern and distribution of MxIC and MnIC was assessed based on sex, location of the jaw, and side of impaction. All OPGs obtained were taken with standardized equipment and specification (KODAK 9000 C 3D, Carestream Health, NY, USA. With a magnification factor of 1.14).

Statistical analysis

Data were processed via SPSS, version 26.0 (IBM Corp., NY, USA). Descriptive and analytical statistical tests were conducted. Sex differences were tested using Student’s Independent sample t-test. Nominal data was analyzed by Chi square with post hoc Bonferroni adjustments and Fisher’s exact test. Statistical significance was determined when \(P\) value < 0.05.

Results

A total of 7466 patients fulfilled the inclusion criteria, of which, 3651 were females and 3815 were males. The mean age was 37.43 years old (SD 14.5). Of the total sample, 173 patients had at least one IC (2.3%). Female to male ratio was 1:1.08 with no statistically significant difference detected. Full sample descriptive statistics is found in Table 1.

Within IC group, 86.71% had IC in the maxilla alone and 8.67% had mandibular canine impaction alone. The percentage of the sample who had at least 1 IC in each jaw was 4.62% [Figure 1].

Among the MxIC group, bilateral impaction occurred in 10.8% of the cases. Females exhibited higher bilateral impaction than males, 64.7% and 35.3% respectively. In the mandible, within the MnIC group, bilateral impactions were relatively higher than the opposite arch (17.4%) with 100% occurrence in males only. However, difference in impaction distribution was not statistically significant according to sex, location, and side of the jaw. Full distribution details are found in Table 2.

Discussion

Frequency of impacted canines

IC is a product of complex interactions between polygenetic and environmental factors.\(^14\)\(^15\) Hence, the incidence of IC varies across different populations and
The frequency of MxIC in this study was 2.1%. Which is in cohort with the range in the orthodontic literature from European populations (0.8% to 2.8%).\[2,9,16\]

In Saudi Arabia, the prevalence of MxIC ranged from as little as 1.44% to 10.1% based on geographic region and population of interest.\[12,13,17‑20\]

In this study, on hospital-based population in Madinah Region, the frequency of MxIC fell within the lower side of that range (2.1%). Similar frequencies were found in Abha (1.44%),\[12\] Jazan (1.89%),\[17\] Jeddah (3.3%),\[18\] and Najran (5.35%).\[19\] The highest frequency of MxIC was reported from Riyadh city: (10.1%)\[20\] and (7.5%).\[13\]

However, their sample size was relatively small and was obtained from orthodontic patients exclusively.

Across gender, females had slightly less MxIC than males (F:M ratio 1:1.08), but no statistically significant difference was found. This contrasted with previous reports which found female predominance in MxIC (F:M ratio ranged from 1.45:1 to 2.1:1).\[17,20\] These wide variations in range could be attributed to disparities in sample size, distribution, characteristics, selection criteria, and different study methodologies.

In the mandible, the frequency of MnIC was found to be 0.1%, which is in cohort with previous reports from Hong Kong (0.07%)\[11\] and Germany (0.1%).\[3\]

Frequencies of MnIC was slightly higher in the United States (0.22%)\[4\] and Jizan, Saudi Arabia (0.4%)\[17\] with ratio of 10:1 MxIC to MnIC, which is comparable to our findings of 7:1 MxIC to MnIC in this sample of Madinah residents. Unlike upper canines, failure of lower canine eruption is mostly due to the presence of physical impediments like crowding and drifting of adjacent teeth.\[21\]

Nevertheless, our findings agree with previous reports regarding the rarity of MnIC compared with MxIC, although females had lower MnIC incidence relative to their male counterparts (F:M ratio 1:1.55). However, no statistically significant difference was detected across gender.

**Distribution pattern of impacted canines**

Single unilateral MxIC occurred in most cases (89.2%). A finding agrees with previous orthodontic literature regarding unilateral impaction being more prevalent than the bilateral.\[13\] Some studies reported equal unilateral left and right MxIC distribution.\[17\] Other studies found left-side impaction more frequent than the right regardless of patient’s sex.\[13,19,22,23\] The finding in this study conforms with the latter. However, no plausible explanation was given regarding left-side impaction predominance in the literature. Females exhibited almost double Bilateral MxIC compared with males (Odds Ratio 2.08), a figure similar to previous reports in the orthodontic literature.\[2,16,24\] The relatively higher bilateral MxIC in females could be attributed to the differences in growth pattern between the sexes as stated by Melha.\[25\] Other local, systemic, and genetic
factors that may be involved in MxIC need to be explored in the scope of sex-related differences.

On the contrary, bilateral MnIC occurred exclusively in males in this cohort. Due to rarity of MnIC in the population, this figure could be purely coincidental in this sample as no statistical significance difference was detected between genders. A study in Turkey reported slightly higher MnIC frequency in males compared with females (F:M ratio 1:1.15); however, no detailed distribution regarding sex and pattern of MnIC was provided. According to Peck, bilateral MnIC is suggestive of genetic determinant. Other authors suggested different etiological factors for MnIC such as ectopic position of tooth germ, early or delayed loss of primary canine, space discrepancies, and abnormal crown morphology. However, the etiology and exact mechanism for MnIC remains unclear.

Strength and limitations
To the best of our knowledge, this study included the largest sample size that is not exclusive to orthodontic patients only, in addition to wider age range and equal gender distribution compared with previous reports from Saudi Arabia. Nonetheless, this study has an inherent bias in sample collection as it was collected retrospectively from a single hospital that represents only one geographic region in Saudi Arabia. Only patients with logged dental records including OPGs were included in the study. Labio-lingual positions of ICs were not evaluated in this study because the supporting diagnostic aids such as radiographs and/or detailed orthodontic records were not readily available for most patients. It would be unethical to expose individuals to unnecessary radiation just to assess the canine position with no intention for treatment. Also, obtaining a representative sample of the population would impose several ethical and financial challenges. Therefore, caution should be exercised when interpreting and generalizing the results of this study.

Conclusion
The frequency of MxIC and MnIC were 2.1% and 0.3%, respectively, in the population of Al-Madinah, Saudi Arabia. Unilateral IC predominated bilateral impaction both in the maxilla and the mandible with most incidences occurring in the left-side of the maxilla. Overall, both genders exhibited almost equal distribution of IC with slight male predominance in the mandibular canine impaction.

Future scope/clinical significance
Further studies are required to investigate the correlation between IC and other predictor etiological factors.

Data availability statement
The data set used in this study is available on request from Asim A. Almarhoumi (email address: amarhoumi@taibahu.edu.sa).

Ethical policy and institutional review board statement
Ethical approval was granted from the Research Ethics Committee, College of Dentistry, Taibah University (approval no. TUCDREC/0822021/ AAlmarhoumi). All the procedures have been performed as per the ethical guidelines laid down by Declaration of Helsinki (2013).

Declaration of patient consent
All the procedures have been performed as per the ethical guidelines laid down by Declaration of Helsinki.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

List of Abbreviations
IC: Impacted Canine; MnIC: Mandibular Impacted Canine; MxIC: Maxillary Impacted Canine; OPG: Orthopantomograph.

References
1. Thilander B, Myrberg N. The prevalence of malocclusion in Swedish schoolchildren. Eur J Oral Sci 1973;81:12:20.
2. Ericson S, Kurol J. Early treatment of palatally erupting maxillary canines by extraction of the primary canines. Eur J Orthod 1988;10:283-95.
3. Rehbrer A. Displaced and impacted canines A radiographic research. Int J Orthod Oral Surg Radiogr 1929;15:1003-20.
4. Grover PS, Lorton L. The incidence of unerupted permanent teeth and related clinical cases. Oral Surg Oral Med Oral Pathol 1985;59:420-5.
5. Bishara SE. Impacted maxillary canines: A review. Am J Orthod Dentofac Orthop 1992;101:159-71.
6. Manne R, Gandikota C, Juuvadi SR, Rama HRM, Anche S. Impacted canines: Etiology, diagnosis, and orthodontic management. J Pharm Bioallied Sci 2012;4(Suppl 2):S234-8.
7. Becker A, Chaushu S. Etiology of maxillary canine impaction: A review. Am J Orthod Dentofac Orthop 2015;148:557-67.
8. Counihan K. Guidelines for the assessment of the impacted maxillary canine. Dent Update 2013;40:770-7.
9. McSherry PF. The ectopic maxillary canine: A review. Br J Orthod 1998;25:209-16.
10. Herrera-Atoche JR, Agüayo-De-Pau MDR, Escoffié-Ramírez M, Aguilar-Ayala FJ, Carrilloc-Ávila BA, Rejón-Peraza ME. Impacted maxillary canine prevalence and its association with other dental anomalies in a Mexican population. Int J Dent 2017;2017:10-3.
11. Chu F, Li T, Lui V, Newsome P, Chow R, Cheung L. Prevalence of impacted teeth and associated pathologies - A radiographic study of the Hong Kong Chinese population. Hong Kong Med J 2003;9:158-63.
12. Mustafa AB. Prevalence of impacted canine teeth in College of Dentistry, King Khalid University- A retrospective study. Int J Heal Sci Res 2014;4:211-4.
13. Al Fawzan AA, Alruwaithi M, Alsadoon S. Prevalence of maxillary canine impaction in orthodontics at Eastern Riyadh specialized dental center. IOSR J Dent Med Sci 2017;16:72-4.
14. Peck S. On the phenomenon of intraosseous migration of nonerupting teeth. Am J Orthod Dentofac Orthop 1998;113:515-7.
15. Becker A, Peck S, Peck L, Kataja M. Palatal canine displacement: Guidance theory or an anomaly of genetic origin?: A letter to the editor from Adrian Becker, with a response from Sheldon and Leena Peck, and Matti Kataja. Angle Orthod 1995;65:95-102.
16. Dachi SF, Howell FV. A survey of 3,874 routine full-mouth radiographs: II. A study of impacted teeth. Oral Surg Oral Med Oral Pathol 1961;14:1165-9.
17. Alhammadi MS, Asiri HA, Almashaqqi AA. Incidence, severity and orthodontic treatment difficulty index of impacted canines in Saudi population. J Clin Exp Dent 2018;10:e327-34.
18. Afify AR, Zawawi KH. The prevalence of dental anomalies in the Western Region of Saudi Arabia. ISRDN Dent 2012/2012:837270.
19. Alyami B, Braimah R, Alharni S. Prevalence and pattern of impacted canines in Najran, South Western Saudi Arabian population. Saudi Dent J 2020;32:300-5.
20. Alkadhi OH, Alfuraid AA, Ajwa NM. Prevalence of different impacted maxillary canine locations in a saudi population in Riyadh City. EC Dental Sci. 2017;13:261-5.
21. Yavuz MS, Aras MH, Büyükkurt MC, Tozoglu S. Impacted mandibular canines. J Contemp Dent Pract 2007;8:78-85.
22. Gashi A, Kamberi B, Ademi-Abdyli R, Pejççi F, Sahatçiu-Gashi A. The incidence of impacted maxillary Canines in a Kosovar population. Int Sch Res Not 2014;2014:1-4.
23. Raji Alrwuili M, Musarrah Alanazi Y, Attallah Alenzi N, Latif K, Ahmed Aljabab M, Mosbah Sabsabi M. Prevalence and localization of impacted canine among Al-Qurayyat orthodontic patients: A study conducted over the period of 4 years. Pakistan Oral Dent J 2016;36:75-8.
24. Hitchin A. The impacted maxillary canine. Br Dent J 1956;100:1-14. Available from: https://ci.nii.ac.jp/naid/10016942713/en/#cit. [Last accessed on 2021 Oct 06].
25. Melha S, Alturki S, Aldawasri G, Almeshari N, Almeshari S, Albadr K. Canine impaction among riyadh population: A single center experience. Int J Oral Heal Sci 2017;7:93-5.
26. Aydin U, Yilmaz HH, Yildirim D. Incidence of canine impaction and transmigration in a patient population. Dentomaxillofacial Radiol 2004;33:164-9.
27. Ando S, Aizawa K, Nakashima T, Sanka Y, Shimbo K, Kiyokawa K. Transmigration process of the impacted mandibular cuspid. J Nihon Univ Sch Dent 1964;6:66-71.
28. Miranti R, Levbarg M. Extraction of a horizontally transmigrated impacted mandibular canine: Report of case. J Am Dent Assoc 1974;88:607-10.
29. Shapira Y, Mischler WA, Kufntinec MM. The displaced mandibular canine. ASDC J Dent Child 1982;49:362-4.