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# The prevalence of dental anomalies among Saudi Population in Makkah, Saudi Arabia

**Dalal T. Mahjoub, Rahaf K. Jarwan[1], Lana A.Z. Filimban[2], Jumanah K. Bahatheq[3], Fayyad S. Alsharif[2], Omar Abdullah M. Alsharif[4], Salem H. Albalawi[5], Ahmed E. Rawas[2] and Rahaf S. Najjar[6]**

*Consultant Orthodontist, King Abdulaziz Hospital, [1]General Dentist, Seraj Medical Care Company, [2]General Dentist, Umm Al-Qura University, Makkah, [3]General Dentist, Smiling Dental Company, Makkah, [4]General Dentist, King Abdulaziz University, [5]Orthodontic Resident, King Abdulaziz Medical City, Jeddah, [6]Pediatric Dentist, King Abdulaziz Hospital, Makkah, Saudi Arabia*

**Address for correspondence:**
Dr. Dalal T. Mahjoub, King Abdulaziz Hospital, Makkah, Saudi Arabia.
E-mail: dalaltmahjoub@gmail.com

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## Abstract

**BACKGROUND:** Morphological and structural abnormalities are common dental anomalies. Identifying DA and determining their prevalence can play an important role in reducing the risk of surgical intervention and improving occlusion, leading to successful dental treatments. Thus, this study aimed to determine the prevalence of DA using panoramic radiographs (OPG) in Makkah, Saudi Arabia according to gender.

**MATERIALS AND METHODS:** A retrospective radiographic investigation was performed, and the digital OPG of 923 patients (age range, 8–27 years) were collected. Records were collected from patients admitted at a government hospital in Makkah between January 2020 and DA in terms of tooth shape (microdontia, macrodontia, gemination, and fusion), number (supernumerary and congenitally missing teeth), and position (impaction and ectopic eruption). Several other abnormalities, such as ankyloses, dens in dents, dilacerations, and taurodontism, have also been reported. Digital radiographs from patients were systematically evaluated to diagnose each radiograph with consistent screen brightness and resolution.

**RESULTS:** The most prevalent DA were impaction (53.8%), hypodontia (13.6%), microdontia (8.2%), and ectopic eruption (6.7%). Taurodontism was observed more frequently in male compared to female (7.5% and 2.2%, respectively). However, there was no significant difference between gender in the distribution of other DA.

**CONCLUSION:** This study found that 27.8% of the Saudi population of Makkah city have DA. Clinical examination and radiographic evaluation are crucial for providing the proper treatment for patients seeking dental treatment.

**Keywords:**

Anomalies, dentistry, hypodontia, population, prevalence, taurodontism

## Introduction

Dental anomalies (DA), are forms of alterations to the human dental structure that arise from disruption during the development of the teeth.[1] The causes of DA are complex resulting from genetic and environmental factors. Genetic factors have been considered to be the most significant factor; however, etiological events in the pre- and post- natal period can have an impact to such anomalies.[2]

Dental anomalies can be defined as an alteration in tooth number, shape, and position.[3] Hypodontia is defined as congenitally missing of one to six teeth, excluding the third molars. Teeth which have failed to erupt clinically in the oral cavity and have no sign of tooth development radiographically are considered as congenitally missing.[4,5]



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Hypodontia could be identified in both the primary and permanent dentition.[6] In contrast, hyperdontia or supernumerary teeth, define as the presence of extra teeth either erupted or unerupted additional to the normal series of either the primary or permanent dentition.[7]

One of the commonly reported anomalies in the tooth position is impaction. Impacted tooth defined as unerupted tooth either completely or partially and is positioned against another tooth, bone or soft tissue so that its unlikely to eruption into its normal position.[8]

Diagnosis of DA requires both clinical and radiographic examinations.[9] Radiography is essential for tracking DA and identifying incidental anomalies that are not reported by patients.[10,11] Dental anomalies are asymptomatic; however, they can cause clinical complications, such as delayed or impaction of the normal series of teeth, poor esthetics, malocclusion, periodontal problems, and increased risk of dental caries.[12]

Globally, many studies showed that there are geographic and cultural differences in the prevalence of DA.[10,13-17] Epidemiological studies on DA have been conducted across the different regions of Saudi Arabia have reported differences in the prevalence of DA.[3,18-23] However, none of them reported the prevalence of DA among the Saudi population in Makkah. In Jeddah, a study stated that congenitally missing teeth were the most reported anomaly (25.7%) with no significant differences regarding gender.[19] Two studies took place in the eastern region of Saudi Arabia, the first study found that rotation was the most common DA (24.5%).[22] However, the other study found that dilaceration was the most reported DA (30.2%) among the population in Eastern Province of Saudi Arabia.[20] Both of the previous studies in addition to many studies have reported no significant correlations between DA and gender.[3,18-20,22]

This study aimed to determine the prevalence of DA that are detectable on panoramic radiograph (OPG) among the population in Makkah city, Saudi Arabia and report the difference in the prevalence of DA according to the patient's gender.

## Materials and Methods

This was a retrospective cross-sectional observational study based on reviewing all the digital OPGs records of patients who attended outpatient dental clinics in any governmental hospital in Makkah city, Saudi Arabia from January 2020 to December 2022. Ethical approval was obtained on March 2023 from Makkah Health Cluster institutional review board (IRB), Saudi Arabia (IRB number: H-02-K-076-0323-916) before beginning the study.

All included records were obtained from patients with the following inclusion criteria: healthy Saudi individuals with ages ranging between 8 and 27 years with no history of tooth extraction. The exclusion criteria were one of the following criteria: history of permanent tooth extraction, history of orthodontic treatment, history of trauma or jaw fracture, have hereditary conditions or syndromes that could cause dental anomalies, and unclear or inaccurate OPGs that may interfere with detection of DA were excluded. The patients' data were collected anonymously.

OPGs were investigated by six trained and calibrated reviewers, who were divided into two groups. Before the beginning of the study, two training sessions were conducted. The first training lecture included a systematic method for interpreting OPGs and radiographic representations of dental anomalies. The second training lecture involved the radiographic cases of OPGs with different dental anomalies recorded by the reviewers. The reviewers' answers were compared to the standard answers of pediatric dentists using kappa statistics for inter-examiner reliability. The agreement was considerable (kappa $\geq 0.75$). Repeatability was evaluated three weeks after the initial examination on seven randomly selected radiographs.

Data were collected using an electronic questionnaire generated at the beginning of the study. Demographic data (gender and age at the time of OPGs acquisition) were recorded for each patient according to the documented information in their files. To maintain patient confidentiality, the patients' identifiable data were not recorded. The anomalies identified on the radiographs were recorded. The electronic questionnaire consisted of multiple items. The first sheet included demographic data and the number of identifiable anomalies. Each identifiable anomaly, including the type, affected tooth, site, and arch, was recorded on a separate sheet. The following dental abnormalities were reported in the patients' OPGs: anomalies in tooth number (supernumerary and congenitally missing teeth [hypodontia]), anomalies in shape (microdontia, macrodontia, gemination, and fusion), and anomalies in tooth position (impaction and ectopic eruption). Additionally, many other abnormalities have been reported, including taurodontism, dens in dents, dilacerations, and ankyloses. The patients' digital OPGs were assessed systematically to diagnose each OPG with uniform screen brightness and resolution.

Data were analyzed using Statistical Package for the Social Sciences (SPSS) Statistics for Windows,

version 28 (IBM Corp., Armonk, N.Y., USA) at a 5% significance level. The frequencies and percentages were calculated to record the prevalence, location, and number of anomalies. Chi-square and Fisher's exact tests were used to report the differences in the prevalence of DA according to the patient's gender.

## Results

A total of 923 patients were included in this study. Their age and gender distribution are summarized in Table 1. Their ages ranged between 8 and 27 years with an arithmetic mean of 16.5 years and a standard deviation of (±) 4.9 years. Female accounted for 56.2% of the participants.

The prevalence of DA among the Saudi population in Makkah city was 27.8% ($n = 257$) as illustrated in Figure 1. Most patients had one dental anomaly (69.3%), where 6.6% had three or more anomalies. A total of 353 DA were reported.

The most frequently reported anomaly type reported in Figure 2. Taurodontism was more observed among males compared to females (7.5% vs 2.2%), $P = 0.018$. There was no significant difference between male and female participants as regards the distribution of other dental anomalies Table 2.

Science impaction was the highest DA among the study sample. The detailed distribution of the impacted teeth is demonstrated in Table 3. Hypodontia was the second most commonly reported DA in our study, and the detailed distribution of teeth affected by hypodontia is shown in Table 4.

The current study reported that the permanent dentition had more dental anomalies (350 teeth) compared to primary dentition (only three teeth). The most frequently affected teeth were the third molars (40.8%) as reported in Figure 3. There was no statistically significant difference between the male and female patients regarding the type of affected tooth (Pearson Chi-square = 9.99, $P = 0.189$). There was no statistically significant difference between the male and female patients regarding the type of affected tooth (Pearson Chi-square = 9.99, $P = 0.189$).

The DA were almost equally distributed between the right, left, and bilateral sides. Gender was not statistically significant for the side affected by the dental anomalies, as presented in Table 5. The upper arch was affected by dental anomalies in 53.8% of the cases, with no significant

**Table 1: Age and gender distribution of the participants (*n*=923)**

| Variable | Description | |
|---|---|---|
| | *n* | % |
| Gender "*n*=923" | | |
| Male | 404 | 43.77 |
| Female | 519 | 56.2 |
| Age in years | | |
| Range | 8-27 | |
| Arithmetic mean±Standard deviation | 16.5±4.9 | |

**Table 2: Gender distribution of dental anomalies in population living in Makkah city, Saudi Arabia**

| Dental anomalies | Patient`s gender | | *P*[a] |
|---|---|---|---|
| | Male *n*=173 *n* (%) | Female *n*=180 *n* (%) | |
| Hypodontia | 26 (15.0%) | 24 (13.3%) | 0.648 |
| Supernumerary | 5 (2.9%) | 9 (5.0%) | 0.315 |
| Impaction | 95 (54.9%) | 95 (52.8%) | 0.987 |
| Ectopic eruption | 11 (6.4%) | 16 (8.9%) | 0.363 |
| Taurodontism | 13 (7.5%) | 4 (2.2%) | 0.018* |
| Daylaceration | 8 (4.6%) | 12 (6.7%) | 0.399 |
| Microdontia | 10 (5.8%) | 19 (10.6%) | 0.099 |
| Macrodontia | 0 (0%) | 2 (1.1%) | 0.258 |
| Others | 2 (1.2%) | 1 (0.6%) | 0.487 |

[a]Chi-square/Fisher Exact test. *Statistically significant

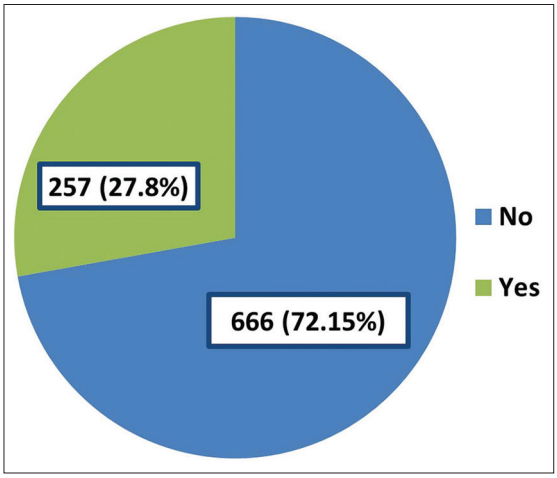


**Figure 1:** Prevalence of dental anomalies among the Saudi population in Makkah city, Saudi Arabia

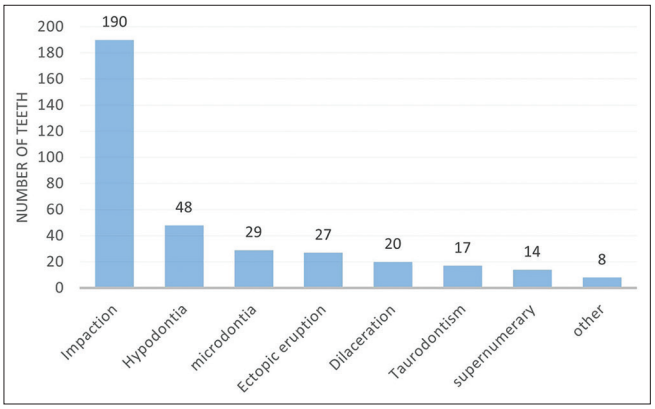


**Figure 2:** Prevalence of different types of dental anomalies among Saudi Population in Makkah City, Saudi Arabia

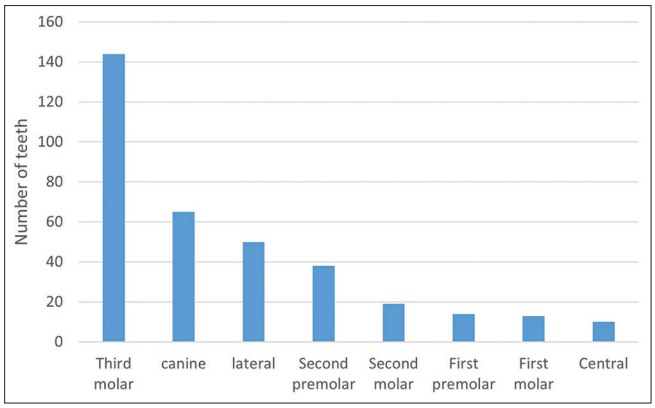


**Figure 3:** Affected teeth among the population with dental anomalies

difference between male and female patients, as shown in Table 6.

## Discussion

This is the first study to include only Saudi patients from Makkah, Saudi Arabia. Only one previous study by Al-Halal *et al*.[24] was conducted in Makkah city in 2017.

Dental anomalies seem to be not rare in Saudi population. Previous studies have reported that the frequency of DA varies among populations. This deviation in the results was mainly caused by racial differences, inconsistent sampling techniques, and different diagnostic criteria.[17,25,26] In the current study, the prevalence of DA was 27.8% which is similar to the findings of two previous studies conducted in Saudi Arabia.[3,27] A study conducted in Jeddah, Kingdom of Saudi Arabia, reported a higher prevalence of DA (45.1%).[19] The difference in findings between the current study and previously mentioned study could be because they only included patients attending orthodontic clinics. These patients usually seek orthodontic treatment with a chief complaint of malocclusion or unpleasant aesthetics. Another study conducted in Makkah city in 2017 reported a higher prevalence of DA (56%), which could be due to differences in the sample design, sample size, and nationalities of the included patients.[24]

The most noticeable DA in our patients was impaction, followed by hypodontia, microdontia, and ectopic eruption. These findings are consistent with those of two previous local studies.[3,24] However, the findings of our study were not in agreement with the results of two other studies conducted locally regarding DA, with a higher prevalence in patients from Saudi. That could be due to the fact that impaction was not one of the anomalies measured in both studies.[21,28]

In the current study, the prevalence of impacted teeth was (20.58%) among the study sample. This finding is similar to the findings of a study conducted in Jeddah city, reported that the prevalence of impacted teeth was 21.1%.[19] In contrast, in a study conducted in Madinah, Saudi Arabia, the prevalence of impacted teeth was 2.5%.[29] The differences in the prevalence of impacted

**Table 3: Distribution of impacted teeth**

| Impacted Tooth | Total *n*=191 (%) | Affected Side *n* (%) | | Affected Arch *n* (%) | |
|---|---|---|---|---|---|
| Third Molar | 119 (62.63%) | Right | 34 (28.57%) | Upper | 30 (25.21%) |
| | | Left | 44 (36.97%) | | |
| | | Bilateral | 41 (34.45%) | Lower | 89 (74.79%) |
| Canine | 45 (23.86%) | Right | 10 (22.22%) | Upper | 24 (53.33%) |
| | | Left | 15 (33.33%) | | |
| | | Bilateral | 20 (44.44%) | Lower | 21 (46.67%) |
| Second Premolar | 18 (9.47%) | Right | 5 (27.78%) | Upper | 4 (22.22%) |
| | | Left | 4 (22.22%) | | |
| | | Bilateral | 9 (50.00%) | Lower | 14 (77.78%) |
| Central | 4 (2.11%) | Right | 0 | Upper | 3 (75.00%) |
| | | Left | 3 (75.00%) | | |
| | | Bilateral | 1 (25.00%) | Lower | 1 (25.00%) |
| Other | 4 (2.11%) | Right | 3 (75.00%) | Upper | 4 (100.00%) |
| | | Left | 1 (25.00%) | | |
| | | Bilateral | 0 | Lower | 0 |

**Table 4: Distribution of teeth affected by hypodontia**

| Hypodontia | Total *n*=48 (%) | Affected Side | | Affected Arch | |
|---|---|---|---|---|---|
| Third Molar | 19 (39.58%) | Right | 5 (26.32% | Upper | 11 (57.89%) |
| | | Left | 4 (21.05% | | |
| | | Bilateral | 10 (52.63% | Lower | 8 (42.11%) |
| Lateral incisor | 14 (29.17%) | Right | 7 (50%) | Upper | 11 (78.57%) |
| | | Left | 1 (7.14%) | | |
| | | Bilateral | 6 (42.86%) | Lower | 3 (21.43%) |
| Second Premolar | 8 (16.67%) | Right | 3 (33.33%) | Upper | 3 (33.33%) |
| | | Left | 2 (22.22%) | | |
| | | Bilateral | 3 (33.33%) | Lower | 5 (55.55%) |
| Other | 7 (14.58%) | Right | 4 (57.14%) | Upper | 6 (85.71%) |
| | | Left | 1 (14.29%) | | |
| | | Bilateral | 3 (42.86%) | Lower | 1 (14.29%) |

**Table 5: Gender distribution of affected side with dental anomalies**

| Affected side | Total *n*=353 (%) | Male *n*=173 (%) | Female *n*=180 (%) |
|---|---|---|---|
| Right | 115 (32.6%) | 61 (35.3%) | 54 (30.0%) |
| Left | 121 (34.3%) | 54 (31.2%) | 67 (37.2%) |
| Bilateral | 117 (33.1%) | 58 (33.5%) | 59 (32.8%) |

Pearson Chi-square=1.69, *P*=0.429

**Table 6: Gender distribution of affected arch with dental anomalies**

| Affected arch | Total *n*=353 (%) | Male *n*=173 (%) | Female *n*=180 (%) |
|---|---|---|---|
| Upper arch | 190 (53.8%) | 96 (55.5%) | 94 (52.2%) |
| Lower arch | 163 (46.2%) | 77 (44.5%) | 86 (47.8%) |

Pearson Chi-square=0.38, *P*=0.538

teeth between the studies can be attributed to the diagnostic criteria used to identify impaction, inclusion criteria, age groups, and sample sizes. The prevalence of impaction among DA was 53.8%, which is consistent with those of several previous local studies.[19,24] Third molars, followed by the canines, second premolars, and central incisors showed a higher incidence of impaction in the current study. Our findings showed that third molars have the highest prevalence of impaction, with an estimated worldwide incidence of 24.4%.[30] A previous study conducted in Makkah reported that the prevalence of impaction was the highest among DA. The teeth with the highest prevalence of impaction were the third molars (89%), canines (7.2%), and premolars (3.2%).[24]

Evaluating the prevalence of canine impaction is important from an orthodontic perspective, and early detection and management are critical for malocclusion prevention and aesthetic maintenance. In our study, we found impacted canines in 45 out of 923 patients (4.87%). Many previous studies have reported the prevalence of canine impaction in Saudi Arabia. The prevalence of impacted canines varies between 1.44 and 4.33% of the study group.[19,24,31,32] A study conducted in Al-Jouf by Alrwuili, *et al*.[33] evaluated patients attending orthodontic clinics and showed that the prevalence of impacted canines was 4.33%, which was most commonly located in the maxilla. In contrast, the current study found that the impacted canines were equally distributed between the maxilla and mandible. This could be due to the younger sample that were included in our study, which may have been too early for the verification of canine impaction, since canines erupted by the age of 12 years. In a study conducted by Al-Halal, *et al*.[24] the prevalence of impacted canines was 27 out of 981 (2.9%). They also reported a higher prevalence of canine impaction in female. However, in our study, there was no significant difference in the prevalence of impaction according to gender.

Hypodontia has been reported to be the most common DA in developing dentition, prevalence of hypodontia varies from 0.03% to 10.1% in different populations.[34] This large range could be caused by differences in sample sizes, diagnostic methods, and patient ages and ethnicities. In this study, the prevalence of hypodontia in the Saudi population was 5.2%. These findings are similar to those of a previous study conducted in Riyadh, in which 6.8% of the study sample had hypodontia.[24] In our study, hypodontia had the second highest prevalence of DA (13.6%). The teeth most affected by this anomaly are the upper third molars, upper lateral incisors, and lower second premolars. Many other studies have excluded the third molar from evaluations of the prevalence of hypodontia.[3,21,28] However, after excluding the third molars, they reported that the most affected teeth were the upper lateral incisors, followed by the lower second premolars, which is similar to the findings of our study. Another local study conducted in Makkah reported that premolars, followed by lateral incisors, had a higher prevalence of hypodontia. In addition, they found that hypodontia was more common in female.[24] However, we found that gender had no significant effect on hypodontia. This difference in results could be due to the different nationalities included in their study.

The third most commonly detected DA in this study was microdontia. Microdontia is one of the most common tooth size discrepancies, particularly in the maxillary lateral incisors.[35] In the current study, we included shape abnormalities, such as microdontia and macrodontia. We identified 29 cases (3.1%) of microdontia in our study population. This finding is similar to the study of Ghaznawi, *et al*.[21] which reported that 5.35% in their sample of the Saudi population had microdontia. In the previous studies, among the reported cases of hypodontia, 96.55% of the cases were reported in the upper lateral incisors, which is similar to the findings of previous studies.[3,18,21] The distribution of hypodontia in the current study was consistent with that of a previous study conducted in Jazan, which reported that unilateral hypodontia was more common than bilateral hypodontia.[18] However, many other studies disagree with this finding.[3,21] This disagreement could be due to differences in study design, inclusion criteria, and cultural differences.

Enlargement of the pulp cavity of a molar tooth at the expense of the root length is defined as taurodontism.[36] Teeth with such anomalies present great challenges during endodontic treatment and require special precautions because their canals are short and close to the orifices.[37,38] This DA was reported in 17 patients (1.8%) in the current study population. This prevalence was similar to the findings of many local and regional studies.[18,24,26] A previous study conducted in Egypt reported that the prevalence of taurodontism in the Egyptian population was 0.6%, with a significantly higher prevalence in male.[39] Also Aljuaid study reported that taurodontism is more common in male patients.[27] These findings are in agreement with those of the present study ($P = 0.027$).

## Conclusion

Based on the findings of this study, the following conclusions were drawn:

- The most prevalent DA in the Saudi population in the Makkah city are impaction followed by hypodontia, microdontia, and ectopic eruptions.
- No statistically significant correlations were observed between gender and DA type, except for taurodontism, which had a significant correlation with male.

- No significant correlations were observed between gender and the site of the affected teeth with DA.

This study may help dentists to wisely evaluate patient radiographs for better diagnosis and management of DA, especially in patients attending dental clinics in Makkah city seeking orthodontic or endodontic treatment.

## Ethical Approval

Ethical approval was obtained on March 2023 from Makkah health cluster institutional review board (IRB), Saudi Arabia (IRB number: H-02-K-076-0323-916) before beginning the study.

## Availability of Data and Materials

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

## Key messages

Identifying DA and determining their prevalence can play an important role in reducing the risk of surgical intervention and improving occlusion, leading to successful dental treatments. The presence of DA may pose challenges for dentists especially for orthodontic and endodontic treatments.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

1. Saberi EA, Ebrahimipour S. Evaluation of developmental dental anomalies in digital panoramic radiographs in Southeast Iranian Population. J Int Soc Prev Community Dent 2016;6:291-5.
2. Kotsomitis N, Dunne MP, Freer TJ. A genetic aetiology for some common dental anomalies: A pilot twin study. Aust Orthod J 1996;14:172-8.
3. Al-Jabaa AH, Aldrees AM. Prevalence of dental anomalies in Saudi orthodontic patients. J Contemp Dent Pract 2013;14:724-30.
4. Jorgenson RJ. Clinician's view of hypodontia. JADA 1980;101:283-6.
5. Pemberton TJ, Das P, Patel PI. Hypodontia: Genetics and future perspectives. Braz J Oral Sci 2005;4:695-706.
6. Arte S. Phenotypic and Genotypic Features of Familial Hypodontia. University of Helsink; 2001.
7. Garvey MT, Barry HJ, Blake M. Supernumerary teeth-an overview of classification, diagnosis and management. J Can Dent Assoc 1999;65:612-6.
8. Janakiraman EN, Alexander M, Sanjay P. Prospective analysis of frequency and contributing factors of nerve injuries following third-molar surgery. J Craniofac Surg 2010;21:784-6.
9. Sivari E, Senirkentli GB, Bostanci E, Guzel MS, Acici K, Asuroglu T. Deep learning in diagnosis of dental anomalies and diseases: A systematic review. Diagnostics (Basel) 2023;13:28.
10. Dang HQ, Constantine S, Anderson PJ. The prevalence of dental anomalies in an Australian population. Aust Dent J 2017;62:161-4.
11. Yonetsu K, Yuasa K, Kanda S. Idiopathic osteosclerosis of the jaws: panoramic radiographic and computed tomographic findings. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1997;83:517-21.
12. Yassin SM. Prevalence and distribution of selected dental anomalies among saudi children in Abha, Saudi Arabia. J Clin Exp Dent 2016;8:485-90.
13. Ardakani FE, Sheikhha M, Ahmadi H. Prevalence of dental developmental anomalies: A radiographic study. Community Dent Health 2007;24:140-4.
14. Goncalves-Filho AJ, Moda LB, Oliveira RP, Ribeiro ALR, Pinheiro JJ, Alver-Junior SM. Prevalence of dental anomalies on panoramic radiographs in a population of the state of Pará, Brazil. Indian J Dent Res 2014;25:648-52.
15. Kositbowornchai S. Prevalence and distribution of dental anomalies in pretreatment orthodontic Thai patients. Khon Kaen Univ Dent J. 2011; 13:25-30.
16. Nemati S, Dalili Z, Dolatabadi N, Javadzadeh A, Mohtavipoor S. Prevalence of developmental and acquired dental anomalies on digital panoramic radiography in patients attending the dental faculty of Rasht, Iran. Journal of Dentomaxillofacial Radiology, Pathology and Surgery 2013;1:24-32.
17. Tsai S, King N. A catalogue of anomalies and traits of the permanent dentition of southern Chinese. J Clin Pediatr Dent 1998;22:185-94.
18. Vani NV, Saleh SM, Tubaigy FM, Idris AM. Prevalence of developmental dental anomalies among adult population of Jazan, Saudi Arabia. Saudi J Dent Res 2016;7:29-33.
19. Afify AR, Zawawi KH. The prevalence of dental anomalies in the Western region of Saudi Arabia. ISRN Dent 2012:2012:837270.
20. ALHumaid J, Buholayka M, Thapasum A, Alhareky M, Abdelsalam M, Bughsan A. Investigating prevalence of dental anomalies in Eastern Province of Saudi Arabia through digital orthopantomogram. Saudi J Biol Sci 2021;28:2900-06.
21. Ghaznawi HI, Daas H, Salako NO. A clinical and radiographic survey of selected dental anomalies and conditions in a Saudi Arabian population. Saudi Dent J 1999;11:8-13.
22. Bakhurji EA, Aldossary F, Aljarbo J, AlMuhammadi F, Alghamdi M, Nazir MA. Prevalence and distribution of nonsyndromic dental anomalies in children in eastern Saudi Arabia: A radiographic study. Sci World J 2021;2021:1-6.
23. Alassiry A. Prevalence and distribution of selected dental anomalies in Najran City of Saudi Arabia. Egypt Dent J 2020;66:1471-82.
24. Al-Halal ZA, Khan N, Lingawi HS. Radiographic prevalence of selected developmental dental anomalies. Int J Health Sci 2017;7:229-34.
25. Al-Emran S. Prevalence of hypodontia and developmental malformation of permanent teeth in Saudi Arabian schoolchildren. Br J Orthod 1990;17:115-8.
26. Ooshima T, Ishida R, Mishima K, Ssizuo. The prevalence of developmental anomalies of teeth and their association with tooth size in the primary and permanent dentitions of 1650 Japanese children. Int J Paediatr Dent 1996;6:87-94.
27. Aljuaid TSS, Manjunatha BS, Amith HV, Alshehri RA, Alharthi FB, Kariri AM. Prevalence and distribution of selected developmental dental anomalies in Taif, Saudi population. J Public Health Res 2022;11:2021-32.
28. Salem G. Prevalence of selected dental anomalies in Saudi Children from Gizan region. Community Dent Oral Epidemiol 1989;17:162-3.
29. Al-Zoubi H, Alharbi AA, Ferguson DJ, Zafar MS. Frequency of impacted teeth and categorization of impacted canines: A retrospective radiographic study using orthopantomograms. Eur J Dent 2017;11:117-21.
30. Carter K, Worthington S. Predictors of third molar impaction: A systematic review and meta-analysis. J Dent Res 2016;95:267-76.
31. Mustafa A. Prevalence of impacted canine teeth in college of

dentistry, King Khalid University—A retrospective study. Int J Health Sci Res 2014;4:211-4.
32. Melha SB, Alturki S, Aldawasri G, Almeshari N, Almeshari S, Albadr K. Canine impaction among riyadh population: A single center experience. Int J Oral Health Sci 2017;7:93-5.
33. Alrwuili MR, Alanazi YM, Alenzi NA, Latif K, Aljabab MA, Sabsabi MM. Prevelence and localization of impacted canine among Al-Qurayyat orthodontic patients: A study conducted over the period of 4 years. Pak Oral Dent J 2016;36:75-8.
34. Mattheeuws N, Dermaut L, Martens G. Has hypodontia increased in Caucasians during the 20th century? A meta-analysis. Eur J Orthod 2004;26:99-103.
35. Proffit WR, Fields HW Jr, Sarver DM. Contemporary Orthodontics. 5th ed. Elsevier India; 2012.
36. Constant D, Grine F. A review of taurodontism with new data on indigenous southern African populations. Arch Oral Biol 2001;46:1021-9.
37. Bronoosh P, Haghnegahdar A, Dehbozorgi M. Prevalence of taurodontism in premolars and molars in the South of Iran. J Dent Res Dent Clin Dent Prospects 2012;6:21-4.
38. Bürklein S, Breuer D, Schäfer E. Prevalence of taurodont and pyramidal molars in a German population. J Endod 2011;37:158-62.
39. Beshr KA, Mossa H. Prevalence of taurodontismin an Egyptian population permanent molar teeth. Egypt Dent J 2018;64:4013-7.