applied sciences

MDPI

Article

Prevalence and Distribution of Dental Anomalies among Arab Orthodontic Patients in Israel: Is There a Correlation to Consanguinity Marriage?

Rana Kadry [1,*], Rojee Atalla [1,†], Tatiana Sella Tunis [1,2], Tamar Finkelstein [1], Shirley Schonberger [1], Johnny Kharouba [3] and Yehoshua Shapira [1]

[1] Department of Orthodontics, The Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University, Tel Aviv 69978, Israel
[2] Department of Anatomy and Anthropology, Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv 69978, Israel
[3] Department of Pediatrics Dentistry, The Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University, Tel Aviv 69978, Israel
* Correspondence: kadry.rana@yahoo.com
† Based on his DMD Thesis.

Abstract: The aim of this study was to determine the prevalence of dental anomalies and whethera significant association exists between dental anomalies and consanguinity marriage among Arabic orthodontic patients in Israel. Pretreatment panoramic radiographs of 513 patients (38% males and 62% females) were examined to detect dental anomalies related to number, size, shape, and eruption. A chi-square test was carried out to determine the associations between dental anomalies, gender, and consanguinity marriage. The results indicated that 29% of the subjects manifested at least one dental anomaly. Impacted tooth was found to be the most frequent dental anomaly, with a prevalence of 13.5%, whereas fusion and transmigration were found to be the least common, with a prevalence of 0.2% each. The prevalence of dental anomalies was significantly greater in males ($p < 0.001$) than in females. In our sample a significant association was found between dental anomalies and consanguinity marriage, and it was found to be greater in subjects with a family history of consanguinity marriage. This association can be attributed to the negative effects of consanguinity marriage, which was also reported in many studies in other fields. This study suggests that consanguinity marriage can be one of the factors involved in the development of dental anomalies in certain at-risk populations.

Keywords: dental anomalies; orthodontics; consanguinity marriage; relative marriages; Arab; Israel

check for updates

Citation: Kadry, R.; Atalla, R.; Sella Tunis, T.; Finkelstein, T.; Schonberger, S.; Kharouba, J.; Shapira, Y. Prevalence and Distribution of Dental Anomalies among Arab Orthodontic Patients in Israel: Is There a Correlation to Consanguinity Marriage? *Appl. Sci.* **2023**, *13*, 197. https://doi.org/10.3390/app13010197

Academic Editor: Andrea Scribante

Received: 1 November 2022
Revised: 15 December 2022
Accepted: 21 December 2022
Published: 23 December 2022

Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

Orthodontists and dental practitioners may find dental anomalies during routine clinical and radiographic examinations, manifested as changes in the number, shape, size, and path of eruption of teeth, also known as developmental dental anomalies.

Dental anomalies often result from a defect in the developmental process of the teeth due to a hereditary or environmental development [1]. Dental anomalies might cause various malocclusions, lack of aesthetics of the teeth and the face and even psychological issues for the patients. Dental anomalies may be manifested as a disturbance in the number, size, shape and composition of the tooth. Disturbances in the number of teeth are manifested as supernumerary or missing teeth. Disturbances in proportions and size are apparent as Macrodontia, Microdontia and short roots. Abnormal morphology of the tooth can be present as Fusion, Dilaceration, Gemination, Taurodontism, Concrescence and Odontoma. Alterations in the chemical composition of the tooth substance can occur in cases of: Hypoplasia, Amelogenesis Imperfecta (AI) and Dentinogenesis Imperfecta [2].

Several studies have shown variations in the percentages of various dental anomalies among different populations, and in different regions in the world. These differences were attributed to differences in race, sampling techniques and diagnostic criteria [3–6].

The Arab population in Israel is characterized by high rates of relative marriages and congenital malformations. An epidemiological review of various types of non-syndromic clefts among Israeli Jews and Arabs, conducted by the Department of Orthodontics at Tel Aviv University, found that the prevalence of congenital malformations was significantly higher among the Arab population [7]. One of the possible explanations for this was attributed to the high prevalence of consanguinity marriages among the Arab population [8].

Consanguinity is defined in genetics as a union between two relatives; second cousins or closure in family. Consanguinity marriages are favored by certain populations; it is usually closely associated with their traditions, beliefs, and the importance of family unity. They are frequently practiced in the Middle East. The rate of relative marriages in various Middle Eastern countries varies from 23.3% to 57.9% [9]. A study was conducted in Israel to assess the prevalence of relative marriages among its Arab population. It was found that 44.3% of the married couples were relatives, and that approximately 22.6% of them were first cousins [10].

Many studies have shown that consanguinity marriages had negative effects on the consanguineous couples' offspring; for example they could lead to; a diminished fertility, a rise in the incidence of mortality and the involvement of congenital malformations, mental retardation, asthma, and epilepsy [11–13]. The offspring of consanguinity marriages are also more prone to develop rare recessive syndromes [14], fetal, newborn, and child mortality [15–17], birth abnormalities [18–20], and later disabilities like deafness [21,22]. Consanguinity may also play a role in—long-term outcomes, such as malignancies in children and young people, breast cancer [23,24] as well as complicated disorders later in life [25,26]. A case report from northern India found that consanguineous marriages are a major risk to the health of offspring and can even cause various craniofacial abnormalities; they increase autosomal recessive allele expression [27]. Despite these negative consequences, the rate of relative marriages is still high among Arabs in Israel, with prevalence of 42% according to a data survey from 2017 [28].

Two studies on dental anomalies among the Arab population in Israel have found a prevalence of 3.7% of impacted canines [29], and 1.1% of missing maxillary lateral incisors [30]. The prevalence of other dental anomalies among the Arab population in Israel has never been investigated. The Arab population constitutes about 20.9% of the total population in Israel [31]. To date, the incidence and distribution of dental anomalies have been examined in Israel only among the Jewish population [32].

This study aimed to (1) determine the incidence and distribution of dental anomalies among the Arab orthodontic patients in Israel, (2) compare the prevalence of dental anomalies between males and females, (3) determine the most common dental anomaly among our sample population, (4) determine whether the prevalence of dental anomalies is higher among families with relative marriage, taking in consideration parents and grandparents that are first/second cousins, as shown in Figure 1.

We hypothesized that the prevalence of dental anomalies among the Israeli Arab population in our sample is high; especially individuals derived from consanguineous marriage families compared to non-consanguineous marriage families.

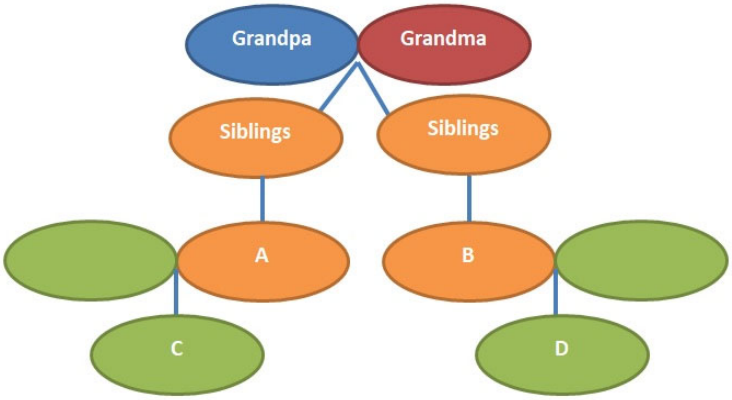


Figure 1. First cousins: A and B, second cousins: C and D.

2. Materials and Methods

2.1. Study Sample

Panoramic radiographs of 513 Arab orthodontic patients were used in this study; 195 males (38%) and 318 females (62%), aged 9 to 30 years old. All medical records were retrieved randomly from three sources: (1) the Department of Orthodontics at the Dental School of Tel-Aviv University, (2) a private orthodontic office in the city of Haifa northern of Israel, and (3) a private orthodontic office in the city of Tira central of Israel. These records were obtained between 1996 and 2019; they were gathered as pretreatment records routinely done prior to orthodontic treatment, with no connection to the present study.

This study was approved by the Institutional Ethical Review Board of Tel Aviv University.

It included high-quality panoramic X-rays of only males and females between the age 9 and 30 years old.

Exclusion criteria included the following: surgery in the head and neck region, previous orthodontic treatment, previous aesthetic dental procedures, root canal treatment, a history of traumatic dental avulsion, a history of previous extraction of permanent teeth and congenital cranio-facial disorders or syndromes.

2.2. Evaluation Procedure

The panoramic radiographs were examined in both jaws in order to identify the desirable dental anomalies for this study, including the permanent and deciduous teeth and excluding the third molars. The number of dental anomalies was recorded. Regarding relative marriages; the first and second cousins parents and grandparents were evaluated. See Figure 1.

2.3. Dental Anomalies

Fourteen dental anomalies were assessed. These anomalies were diagnosed according to the criteria shown in Figure 2, Table 1.

2.4. Statistical Analysis

The data were recorded and analyzed using the SPSS software package (Statistical 1 Package for Social Sciences, version 20.0, SPSS, Inc., Chicago, IL, USA). A frequency table was created to provide a general description of the dental anomalies in males and females. A chi-square test was carried out to detect a significant association between dental anomalies, gender, and relative marriages. We also used Spearman's rank correlation coefficient to quantify the extent of statistical dependence between the following variables: relative marriages, the degree of relativity (first or second cousins), the number of anomaly cases, and the number of teeth involved in every case. The level of statistical significance was set at $p < 0.05$.

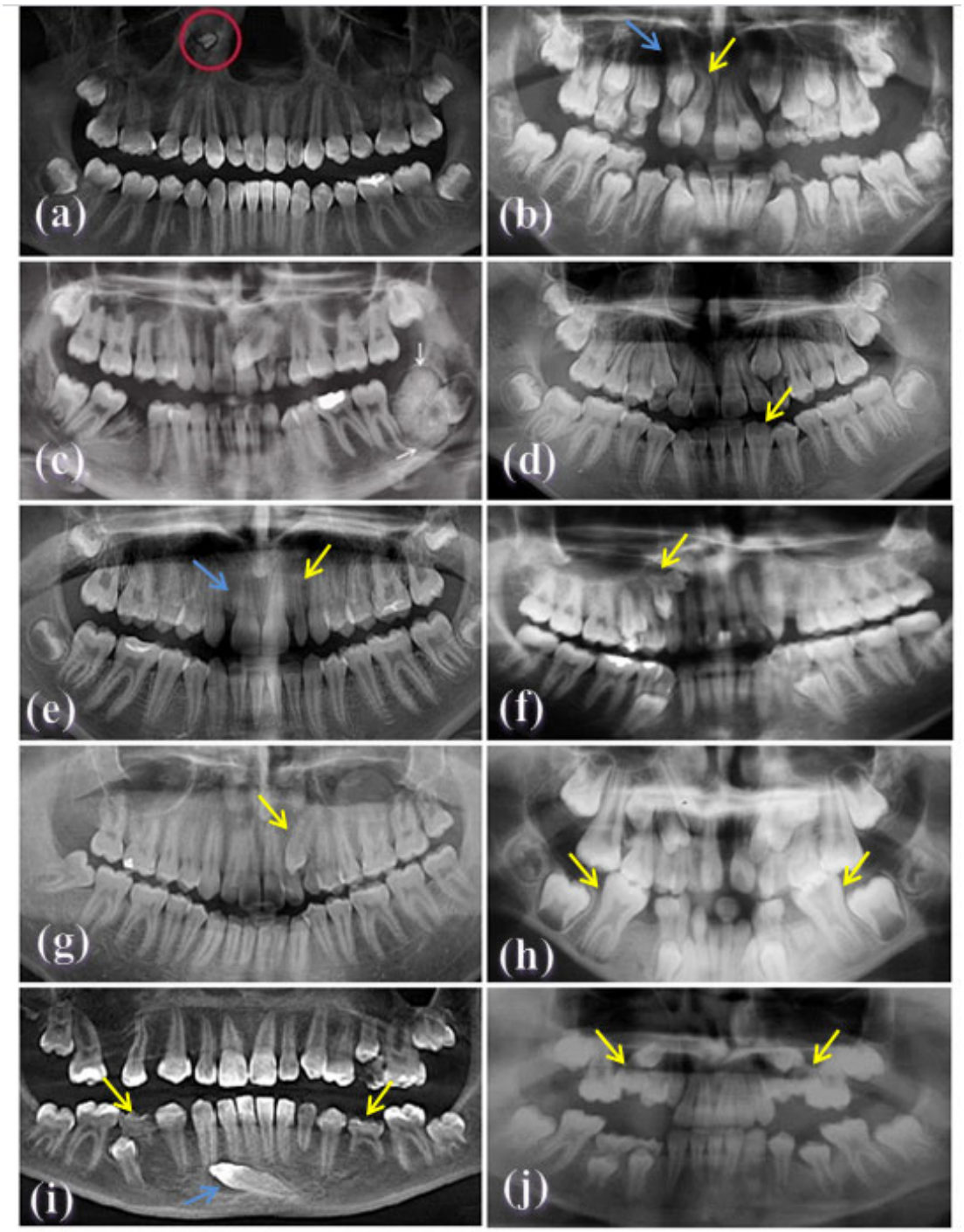


Figure 2. Examples of dental anomalies evaluated on panoramic radiographs: (**a**) an ectopic supernumerary tooth located at the right maxillary sinus (red circle) (a 16 year-old patient); (**b**) dilaceration of tooth #11 (yellow arrow), and transposition of the maxillary lateral incisor and canine (blue arrow) (a 12-year-old patient); (**c**) compound odontoma at the left angle of the mandible (white arrows) (a 21-year-old patient); (**d**) fusion of teeth #31 and #32 (yellow arrow) (a 14-year-old patient); (**e**) an example of missing teeth #12 (blue arrow), and a peg shaped toot #12 (yellow arrow) (a 16-year- old patient); (**f**) gemination (yellow arrow) (a 25-year-old patient); (**g**) an impacted upper canine #23 (yellow arrow) (a 24-year-old patient); (**h**) taurodontia of lower first molars (yellow arrows) (a 7-year-old patient); (**i**) transmigration of the lower canine (blue arrow) and retained teeth #75 and #85 (yellow arrows) (a 13-year-old patient); and (**j**) subemerged primary upper second molars (yellow arrows) (a 9-year-old patient).

Table 1. Dental anomalies considered in the current study and their diagnostic criteria.

Dental Anomaly	Diagnostic Criteria
Missing teeth	Lack of development of one or more permanent teeth.
Supernumerary teeth	An excess in the normal number of permanent teeth due to the development of additional teeth.
Peg-shaped teeth	A tooth with an incisor mesio-distal width smaller than its cervical width [33].
Fusion	Union between two separate tooth buds during dental development involving the crowns and/or the roots [34].
Gemination	Inadequate division of a tooth germ, resulting in the formation of two partially or completely separated crowns with one root and one root canal. It is clinically characterized by incisal notching on an enlarged crown [34].
Transposition	Interchange in the position of two adjacent permanent teeth in the same quadrant of the dental arch [35].
Transmigration	Movement of an impacted tooth across the jaw midline [36].
Ectopic	An erupted tooth that is not in its proper position in the dental arch (e.g., the tooth is located mesially/distally or vestibularlly/orally outside the dental arch [37].
Impaction	Interruption in the eruption of a tooth caused by a clinically or radiographically detectable physical barrier in the eruption path, or because of an abnormal position of the tooth [38,39].
Submerged	A deciduous erupted tooth that failed to reach the occlusal level of the fully erupted adjacent teeth by at least 2 mm.
Retained	Failure of the primary tooth to exfoliate at the proper developmental stage (more than one year late to erupt from its permanent successor) [39].
Dilacerations	Teeth with bends or changes in the long axis of their crowns, crown-roots, or roots. This is usually following trauma to the developing tooth bud.
Taurodontism	The furcation areas on the molar teeth are located more epically than normal, and the pulp chamber appears elongated as a result. This anomaly is detected in radiographs and is seen in both dentitions, but is morecommon in the permanent dentition [2].
Odontoma	An odontoma is a tumor-like malformation that contains elemental tooth matrix materials [40].

2.5. Reliability

In order to reduce errors due to intra- and inter-operators variability, 20 panoramic radiographs were chosen randomly; a kappa test was conducted to calculate the reliabilities for each dental anomaly and to determine the ability to accurately replicate the diagnosis of dental anomalies. The dental radiographs where examined twice by the same researcher (R.A.); a D.M.D student who was previously trained to diagnose dental anomalies (two weeks apart and blinded to the initial screening results), and by an additional independent researcher (R.K.), who is specialist in orthodontics and is a clinical instructor in the Department of Orthodontics.

3. Results

3.1. Reliability Analysis

The kappa values obtained showed high reproducibility for dental anomaly evaluation, ranging between 0.930 and 1.000.

3.2. General Prevalence of Dental Anomalies

Studied (n = 513), at least one of the 14 examined dental anomalies was involved. The prevalence of each studied dental anomaly appears in Table 2. Tooth impaction (13.5%) was the most frequent anomaly, and fusion and transmigration were the least frequent (0.2% each). The prevalence of seven dental anomalies was less than 1%. These anomalies included Gemination, Fusion, Taurodontia, Dilacerations, Submerged teeth, Transmigration and Odontoma.

Table 2. Prevalence of dental anomalies by gender.

Dental Anomaly	Gender	*n*	Prevalance (%)	*p*-Value [1]
Missing teeth	Male	16	8.2	0.589
	Female	22	6.9	
	Total	38	7.4	
Supernumerary teeth	Male	1	0.5	0.404
	Female	4	1.3	
	Total	5	1	
Peg-shaped teeth	Male	2	1	0.927
	Female	3	0.9	
	Total	5	1	
Fusion	Male	1	0.5	0.201
	Female	0	0	
	Total	1	0.2	
Gemination	Male	2	1	0.700
	Female	0	0	
	Total	2	0.4	
Transmigration	Male	0	0	0.433
	Female	1	0.3	
	Total	1	0.2	
Ectopic	Male	16	8.2	0.750
	Female	14	4.4	
	Total	30	5.8	
Impaction	Male	38	19.5	**0.002**
	Female	31	9.7	
	Total	69	13.5	
Submerged	Male	1	0.5	0.807
	Female	2	0.6	
	Total	3	0.6	
Retained	Male	6	3.1	0.705
	Female	8	2.5	
	Total	14	2.7	
Dilacerations	Male	1	0.5	0.726
	Female	1	0.3	
	Total	2	0.4	
Taurodontism	Male	1	0.5	0.590
	Female	3	0.9	
	Total	4	0.8	
Odontoma	Male	1	0.5	0.726
	Female	1	0.3	
	Total	2	0.4	

[1] *p*-values for the difference between the genders. Significant values are denoted in bold.

The distribution of dental anomalies between the genders is shown in Table 2. It was found that the prevalence of dental anomalies was significantly higher ($p < 0.001$) in males, according to the chi-square test. Interestingly, (37.9%) of the 195 participants from the male group presented the presence of a dental anomaly, compared with 23.9% of the 318 women who participated in this study.

3.3. Severity of Dental Anomalies

The number of dental anomalies in each case is shown in Figure 3. We found that the highest number of dental anomalies was two anomalies per case in both groups (males/females). Among the 74 cases of dental anomalies in males, there was one anomaly for (62) 83.8% and there were two anomalies for (12) 16.2% of the subjects. Among the

76 cases in the females, there was one anomaly for (64) 84.2%, and there were two anomalies for (12) 15.8% of the subjects.

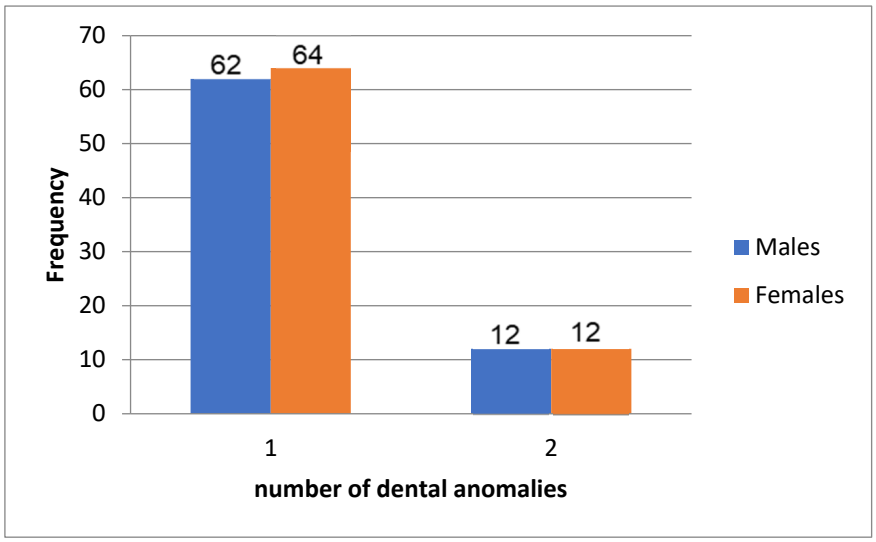


Figure 3. The number of dental anomalies in each case among males (blue) and females (red).

The number of teeth involved in each case is shown in Figure 4. We found that the highest number was 12 teeth per case in both groups (males/females). This number was present only in two cases, one male and one female. The most common number of teeth involved in every case was found to be one tooth in males (32) 34.24% and two teeth in females (37) 48.68%.

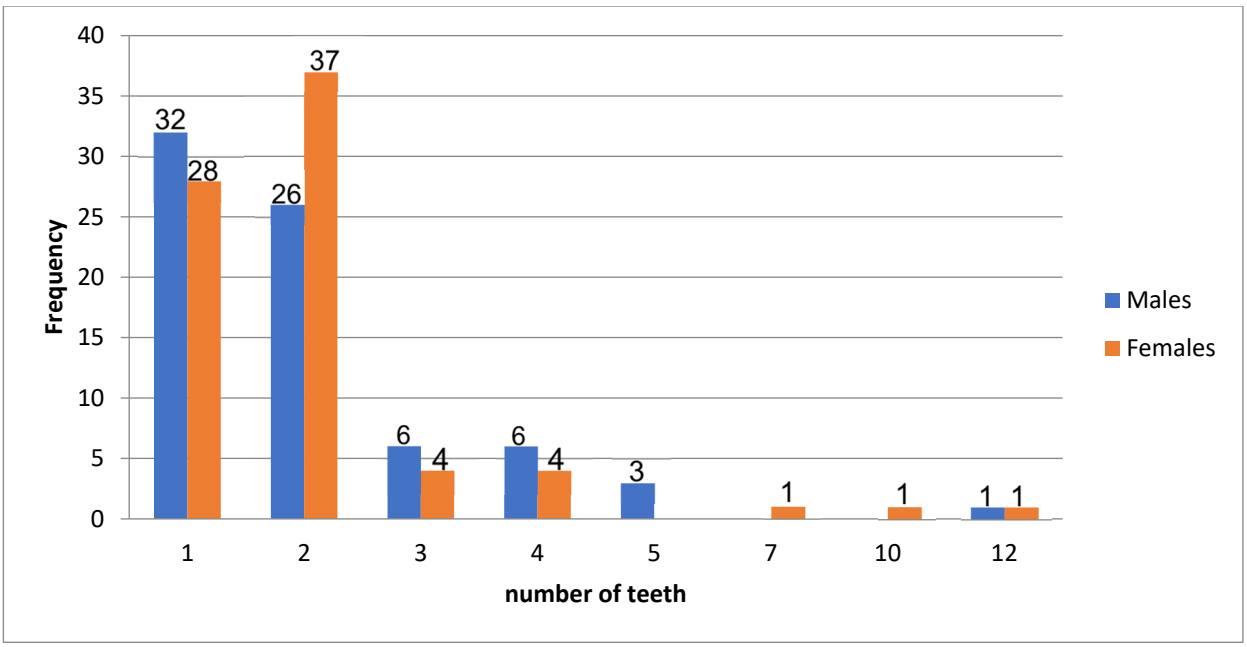


Figure 4. The number of teeth involved in each case among males (blue) and females (red).

3.4. Consanguinity

The sample was divided into two main groups: individuals with and without consanguinity The prevalence of dental anomalies is shown in Table 3.

Table 3. The prevalence of dental anomalies by consanguinity groups.

	With Consanguinity	Without Consanguinity	Total
With a dental anomaly	45	105	150
Without a dental anomaly	34	329	363
Total	79	434	513

Dental anomalies were found in 66.67% (24) of the 36 males with relative marriages whereas they were present in only 31.45% (50) of those who did not have any consanguinity.

The group of females had similar findings. Dental anomalies were found in 48.84% (21) of the 43 females with relative marriages, whereas it was present in only 20% (55) of females who did not have any consanguinity. The results are shown in Figure 5.

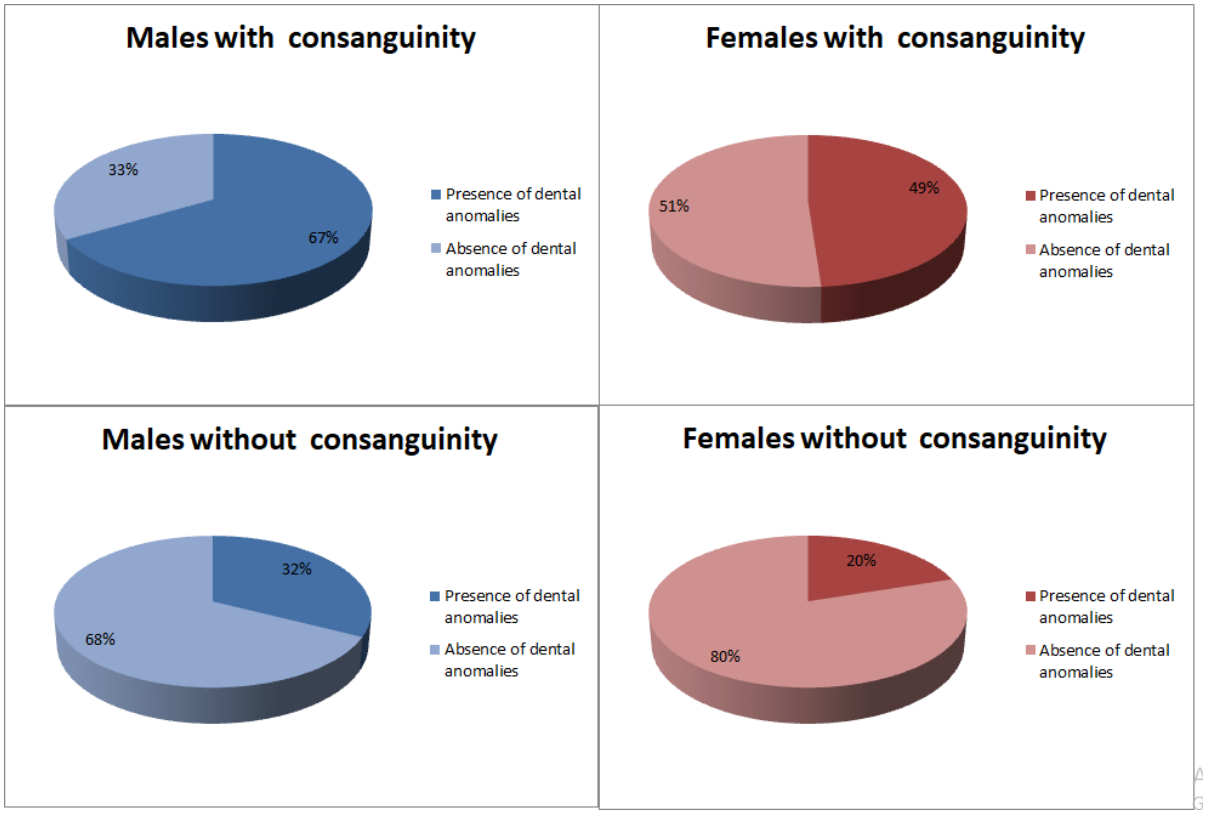


Figure 5. Percentage of dental anomalies among men and women according to relative marriages (All percentages were rounded off to the nearest integer).

4. Discussion

4.1. Dental Anomalies: General Prevalence, Gender, the Number of Anomalies and the Teeth Involved

In the current study, we found that (150) 29.24% of the subjects in our sample, displayed at least one dental anomaly. The most common dental anomaly was tooth impaction (13.5%), followed by missing teeth (7.4%) and ectopic tooth eruption (5.8%), whereas fusion and transmigration were found to be the least common, with a prevalence of 0.2% each. The prevalence of dental anomalies was significantly greater in males ($p < 0.001$). These results are similar to the findings reported among the Jewish population in Israel [31], where no significant differences were found between males and females. In another study carried out among the Turkish population, it was found that the general prevalence of dental anomalies was 14.3%, whereas tooth impaction was 5.5% which was the most common anomaly thus is similar to our study, with no significant difference between males and females [41]. However, another study conducted in Turkey reported that impaction

(46.51%) was the most widespread anomaly [42]. In addition, a study carried out among the Indian population presented a higher prevalence in men than in women, and the overall prevalence of dental anomalies was 57.43%, where hyperdontia was the most common anomaly (0.1–3.8%) [43]. Another study that was conducted in India to determine the prevalence of impacted maxillary canines found that males were more commonly affected by impacted maxillary canines than were females [44].

Two studies of the Arab population in Israel found a prevalence of 3.7% of impacted canines, with higher prevalence in females [29] as well as 1.1% of missing maxillary lateral incisors [30] Other anomalies were not investigated earlier in the Arab population in Israel. As can be seen, different populations demonstrate different results. The awareness of the high prevalence of dental anomalies in general, and impactions in particular, in our population should be highly considered in early diagnosis, preventive, and interceptive treatments.

Although the sample size and the sampling study technique affects the results of different studies, variations in the prevalence of dental anomalies among different studies may indicate the involvement of genetic, racial, and environmental factors.

4.2. Dental Anomalies and Consanguinity

Our study also aimed to determine whether a significant association exists between dental anomalies and consanguinity marriages in Arabic orthodontic patients in Israel. According to the results, the percentage of cases in which dental anomalies were present was at least two times greater in the group of participants that had a family marriage relationship, than in the group where consanguineous marriages did not exist. The chi-square test indicated a significant association between dental anomalies and consanguinity marriages ($p < 0.05$). Among the group of participants with consanguinity, we also examined the relationship between the number of dental anomalies in every case and the degree of family relations (first/second cousins); however, no significant relationship was found between them according to Spearman's correlation test.

Although the relationship between body and facial disorders and consanguinity has been numerously investigated, few investigations have been conducted in dentistry. Our results are in accordance with the results reported in previous studies; a study conducted in Turkey among non-syndromic patients reported a significant correlation between dental anomalies and consanguinity marriage [45]. Lakshmayya reported a higher prevalence of malocclusion, non-syndromic oligodontia, and enamel hypoplasia in individuals who had consanguineous marriage offspring [27]. Another study in India reported that the frequency of non-syndromic dental anomalies was higher than that of the non-consanguineous ones [46]. Abbas et al. found that congenital dental anomalies were significantly associated with consanguineous marriages, with a greater incidence in lower socioeconomic groups [47].

It is known that the etiology of various dental anomalies is multifactorial, which is partly related to certain genes as well as to events in the period before and after birth, which could constitute a factor that may cause abnormalities in the size, shape, location, number, and structure of the teeth [48–52]. The distinct relationship found between dental anomalies and consanguineous marriages, according to our study, is an important consideration, for dentists in general and orthodontists in particular, for better understanding the etiology of dental anomalies and the factors that influence their development, since the treatment is multidisciplinary and usually requires orthodontic intervention. The higher prevalence of dental anomalies among Arab orthodontic patients in Israel is probably due to genetic and environmental factors and to a higher prevalence of consanguinity. Genetic counseling and education about the anticipated genetic consequences of consanguinity is required in order to reduce the prevalence of body, orofacial and dental abnormalities aiming to promote healthcare programs that will discourage consanguineous marriages [53].

4.3. Study Limitations

For ethical reasons, our sample included only records from orthodontic patients. Panoramic radiographs already existed prior to orthodontic treatment. Patients seeking orthodontic treatment may tend to display more dental anomalies and the results of this study may not reflect the actual prevalence among the Arab population in Israel. A future study including patients from other dental disciplines is needed to represent a larger range of the Arabic population in Israel. In addition, our study sample included only non-syndromic patients, to eliminate dental anomalies related to syndromes at this stage and to eliminate bias within the study. However, we should not ignore the fact that syndromes are related to consanguinity and that this increases the association between dental anomalies derived from such syndromes and consanguinity marriage. This will be investigated in a future study.

5. Conclusions

In this study, we found a high prevalence of dental anomalies among the Israeli Arab orthodontic patients; impacted teeth were found to be the most common anomaly. In addition, it was found that the prevalence of dental anomalies among men is significantly higher than among women. Early diagnosis of dental anomalies, such as impacted teeth, is important for developing an appropriate orthodontic treatment plan including management of the anomaly at an appropriate time. Some of the dental anomalies are considered as part of the indications for early orthodontic treatment in order to prevent future complications and to provide the patients with functional and aesthetical results. Importantly, a significant association was found between relative marriages and the presence of dental anomalies. On the other hand, no relationship was found between the type and degree of consanguinity and the number of dental anomalies or teeth involved. Apparently, consanguineous marriages have negative consequences and effects that are associated with the development of teeth, which could be manifested by different types of anomalies as well as the development of other developmental defects in the body.

This study sheds light on additional medical issues that require significant consideration. In addition suggests that the dentist/orthodontist should take into consideration consanguinity marriage as another etiological factor in dental anomalies.

Author Contributions: Concepualization, Y.S.; Investigation, R.K. and J.K.; Methodology, T.F., Data Curation, R.A.; Visualization, S.S.; Validation T.S.T.; Writing-review & editing, R.K., R.A. and Y.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funging.

Institutional Review Board Statement: The study was conducted in accordance with the Declarationof Helsinki and approved by the Institutional Ethics committee of Tel Aviv University.(No protocol code number).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data of the study are available from the corresponding author on request.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Altug-Atac, A.T.; Erdem, D. Prevalence and distribution of dental anomalies in orthodontic patients. *Am. J. Orthod. Dentofac. Orthop.* **2007**, *131*, 510–514. [CrossRef] [PubMed]
2. Ansari, G.; Mojtaba, V.G.; Welbury, R. Atlas of Pediatric Oral and Dental Developmental Anomalies. *Internet. Resour.* **2019**, *4*, 21–61.
3. Clayton, J.M. Congenital dental anomalies occurring in 3557 children. *J. Dent. Child* **1956**, *23*, 206–218.
4. Shah, R.M.; Boyd, M.A.; Vakil, T.F. Studies of permanent tooth anomalies in 7,886 Canadian individuals. I: Impacted teeth. *Dent. J.* **1978**, *44*, 262–264. [PubMed]

5. Ooshima, T.; Ishida, R.; Mishima, K.; Sobue, S. 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. [CrossRef] [PubMed]
6. Thongudomporn, U.; Freer, T.J. Prevalence of dental anomalies in orthodontic patients. *Aust. Dent. J.* **1998**, *43*, 395–398.
7. Shapira, Y.; Blum, I.; Hakali, Z.; Shpack, N.; Amitai, Y. Prevalence of non-syndromic orofacial clefts among Jews and Arabs, by type, site, gender and geography: A multicenter study in Israel. *Isr. Med. Assoc. J.* **2014**, *16*, 759–763.
8. Zlotogora, J. Genetic disorders among Palestinian Arabs. Effect of consanguinity. *Am. J. Med. Genet.* **1997**, *68*, 472–475. [CrossRef]
9. Teebi, A.S. Autosomal recessive disorder among Arabs: An overview from Kuwait. *J. Med. Genet.* **1994**, *38*, 163–167. [CrossRef]
10. Jaber, L.; Bailey-Wilson, J.E.; Hai-Yehia, M.; Hermandez, J.; Shohat, M. Consanguineous mating in an Israeli-Arab community. *Arch. Pediatr. Adolesc. Med.* **1994**, *148*, 412–415. [CrossRef]
11. Al Ansari, A. Etiology of mild mental retardation among Bahraini children: A community-based case control study. *Ment. Retard.* **1993**, *31*, 140–143. [PubMed]
12. Jaber, L.; Merlob, P.; Gabriel, R.; Shohat, M. Effects of consanguineous marriage on reproductive outcome in an Arab community in Israel. *J. Med. Genet.* **1997**, *34*, 1000–1002. [CrossRef] [PubMed]
13. Bener, A.; Hussain, R. Consanguineous unions and child health in the State of Qatar. *Paediatr. Perinat. Epidemiol.* **2006**, *20*, 372–378. [CrossRef] [PubMed]
14. Chakraborty, R.; Chakravarti, A. On consanguineous marriages and the genetic load. *Hum. Genet.* **1977**, *36*, 47–54. [CrossRef] [PubMed]
15. Khoury, S.A.; Massad, F. Consanguinity, fertility, reproductive wastage, infant mortality, and congenital malformations in Jordan. *Saudi Med. J.* **2000**, *21*, 150–154. [PubMed]
16. Mokhtar, M.; Abdel Fattah, M.M. Consanguinity and advanced maternal age as risk factors for reproductive losses in Alexandria, Egypt. *Eur. J. Epidemiol.* **2001**, *17*, 559–565. [CrossRef]
17. Zlotogora, J.; Leventhal, A.; Amitai, Y. The impact of congenital malformations and Mendelian diseases on infant mortality in Israel. *Isr. Med. Assoc. J.* **2003**, *5*, 416–418.
18. Bromiker, R.; Glam Baruch, M.; Gofin, R.; Hammerman, C.; Amitai, Y. Association of parental consanguinity with congenital malformation among Arab newborns in Jerusalem. *Clin. Genet.* **2004**, *66*, 63–66. [CrossRef]
19. Sawardekar, K.P. Profile of major congenital malformations at Nizwa Hospital, Oman: 10-year review. *J. Pediatr. Child Health* **2005**, *41*, 323–330. [CrossRef]
20. Harlap, S.; Kleinhaus, K.; Perrin, M.; Calderon-Margalit, R.; Paltiel, O.; Deutsch, L.; Manor, O.; Tiram, E.; Yanetz, R.; Friedlander, Y. Consanguinity and birth defects in the Jerusalem perinatal study cohort. *Hum. Hered.* **2008**, *66*, 180–189. [CrossRef]
21. Al Khabori, M. Causes of severe to profound deafness in Omani paediatric population. *Int. J. Pedia. Otorhinolaryngol.* **2004**, *68*, 1307–1313. [CrossRef] [PubMed]
22. Zlotogora, J.; Carasquillo, M.; Barges, S.; Shalev, S.A.; Hujerat, Y.; Chakravarti, A. High incidence of deafness from three frequent connexin 26 mutations in an isolated community. *Genet. Test.* **2006**, *10*, 40–43. [CrossRef]
23. Bener, A.; Denic, S.; Al Mazrouei, M. Consanguinity and family history of cancer in children with leukemia and lymphomas. *Cancer* **2001**, *92*, 1–6. [CrossRef] [PubMed]
24. Masood Gilani, G.; Kamal, S. Risk factors for breast cancer in Pakistani women aged less than 45 years. *Ann. Hum. Biol.* **2004**, *31*, 398–407. [CrossRef] [PubMed]
25. Barbari, A.; Stephan, A.; Masri, M.; Karam, A.; Aoun, S.; El Nahas, J.; Khalil, J.B. Consanguinity-associated kidney diseases in Lebanon: An epidemiological study. *Mol. Immu.* **2003**, *39*, 1109–1114. [CrossRef]
26. Pasotti, M.; Repetto, A.; Tavazzi, L.; Arbustini, E. Genetic predisposition to heart failure. *Medi. Clinz.* **2004**, *88*, 1173–1192. [CrossRef]
27. Lakshmayya Naidu, D.; Srinivasa Raju, M.; Goel, S. Effects of consanguineous marriages on oral and craniofacial structures: A study on dental patients in north India. *Ann. Essences Dent.* **2010**, *2*, 4–199. [CrossRef]
28. Sharkia, R.; Khatib, M.; Sheikh-Muhammad, A.; Mahajnah, M.; Zalan, A. The prevailing trend of consanguinity in the Arab society of Israel: Is it still a challenge? *J. Biosoc. Sci.* **2021**, *6*, 1–5. [CrossRef]
29. Watted, N.; Abu-Hussein, M.; Awadi, O.; Watted, M.; Watted, A.-L.; Watted, A. Clinical Study Of Impacted Canine In The Arab Population In Israel. *J. Oral. Health Comm. Dent.* **2015**, *9*, 81–88.
30. Abu-Hussein, M.; Watted, N.; Azzaldeen, A.; Yehia, M.; Awadi, O.; Abu-Hussein, Y. Prevalence of missing lateral incisor agenesis in an orthodontic Arabs population in Israel (Arab48). *Int. J. Public Health Res.* **2015**, *3*, 101–107.
31. Israel Central Bureau of Statistics. *Population of Israel on the Eve of 2019*; Israel Central Bureau of Statistics: Jerusalem, Israel, 2019.
32. Sella Tunis, T.; Sarne, O.; Hershkovitz, I.; Finkelstein, T.; Pavlidi, A.M.; Shapira, Y.; Davidovitch, M.; Shpack, N. Dental Anomalies' Characteristics. *J. Diagn.* **2021**, *11*, 1161. [CrossRef] [PubMed]
33. Hua, F.; He, H.; Ngan, P.; Bouzid, W. Prevalence of peg-shaped maxillary permanent lateral incisors: A meta-analysis. *Am. J. Orthod. Dentofac. Orthop.* **2013**, *144*, 97–109. [CrossRef] [PubMed]
34. Finkelstein, T.; Shapira, Y.; Bechor, N.; Shpack, N. Fused and Geminated Permanent Maxillary Central Incisors: Prevalence, Treatment Options, and Outcome in Orthodontic Patients. *J. Dent. Child.* **2015**, *82*, 147–152.
35. Shapira, Y.; Kuftinec, M.M. Tooth transpositions—A review of the literature and treatment considerations. *Angle Orthod.* **1989**, *59*, 271–276. [PubMed]

36. Mazinis, E.; Zafeiriadis, A.; Karathanasis, A.; Lambrianidis, T. Transmigration of impacted canines: Prevalence, management and implications on tooth structure and pulp vitality of adjacent teeth. *Clin. Oral. Investig.* **2012**, *16*, 625–632. [CrossRef]
37. Bondemark, L.; Tsiopa, J. Prevalence of ectopic eruption, impaction, retention and diagenesis of the permanent second molar. *Angle Orthod.* **2007**, *77*, 773–778. [CrossRef]
38. Bedoya, M.M.; Park, J.H. A review of the diagnosis and management of impacted maxillary canines. *J. Am. Dent. Assoc.* **2009**, *140*, 1485–1493. [CrossRef]
39. Raghoebar, G.M.; Boering, G.; Vissink, A.; Stegenga, B. Eruption disturbances of permanent molars: A review. *J. Oral. Pathol. Med.* **1991**, *20*, 159–166. [CrossRef]
40. Cabay, R.J. An overview of molecular and genetic alterations in selected benign odontogenic disorders. *Arch. Pathol. Lab. Med.* **2014**, *138*, 754–758. [CrossRef]
41. Aren, G.; Guven, Y.; Guney Tolgay, C.; Ozcan, I.; Bayar, O.F.; Kose, T.E.; Koyuncuoglu, G.; Ak, G. The prevalence of dental anomalies in a Turkish population. *J. Istanb. Univ. Fac. Dent.* **2015**, *49*, 23–28. [CrossRef]
42. Gokcek, M.; Cirakoglu, N.Y. Determination of the prevalence of dental anomalies by digital panoramic radiography analysis. *Medicine* **2021**, *10*, 1128–1132.
43. Guttal, K.S.; Naikmasur, V.G.; Bhargava, P.; Bathi, R.J. Frequency of developmental dental anomalies in the Indian population. *Eur. J. Dent.* **2010**, *4*, 263–269. [CrossRef] [PubMed]
44. Bharathi, A.R.; Santhanam, A.; Sivakumar, M. Prevalence of impacted maxillary canines and its association with other dental anomalies. *Int. J. Dent. Oral Sci.* **2021**, *8*, 1757–1760.
45. Bağcı, N.; Pamukçu, U.; Altunkaynak, B.; Peker, İ. Dental anomalies in consanguineous marriage: A clinical-radiological study. *Int. Dent. J.* **2022**, *72*, 133–140. [CrossRef] [PubMed]
46. Khan, S.Y. An exploratory study of consanguinity and dental developmental anomalies. *Int. J. Clin. Pediatr. Dent.* **2018**, *11*, 513–518. [CrossRef] [PubMed]
47. Abbas, B.; Abbas, S.; Malik, S.M.; Rahim, M.; Umair, M.; Khurshid, Z. Consanguineous Marriages and Dental Anomalies: A Cross-Sectional Analytical Study. *Int. J. Dent.* **2022**, *2022*, 9750460. [CrossRef]
48. Basdra, E.K.; Kiokpasoglou, M.; Stellzig, A. The Class II Division 2 craniofacial type is associated with numerous congenital tooth anomalies. *Eur. J. Orthod.* **2000**, *22*, 529–535. [CrossRef]
49. Baydas, B.; Oktay, H.; Metin Dagsuyu, I. The effect of heritability on Bolton tooth-size discrepancy. *Eur. J. Orthod.* **2005**, *27*, 98–102. [CrossRef]
50. Garn, S.M.; Lewis, A.B.; Kerewsky, R.S. X-LINKED inheritance of tooth size. *J. Dent. Res.* **1965**, *44*, 439–441. [CrossRef]
51. Kotsomitis, N.; Dunne, M.P.; Freer, T.J. A genetic etiology for some common dental anomalies: A pilot twin study. *Aust. Orthod. J.* **1996**, *14*, 172–178.
52. Sofaer, J.A. Human tooth-size asymmetry in cleft lip with or without cleft palate. *J. Arch. Oral Biol.* **1979**, *24*, 141–146. [CrossRef] [PubMed]
53. Shapira, Y.; Blum, I.; Haklai, Z.; Shpack, N.; Amitai, Y. Nonsyndromic orofacial clefts among Jews and non-Jews born in 13 hospitals in Israel during 1993–2005. *Community Dent. Oral Epidemiol.* **2018**, *46*, 586–591. [CrossRef] [PubMed]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.