

Prevalence of infraocclusion in primary molars and accompanying dental variations in a Turkish sample

Zulfikar Zahit Ciftci PhD¹, Zuhal Kirzioglu PhD², Aysegul Saritekin PhD³

Original Article

Abstract

BACKGROUND AND AIM: Infraocclusion, a disorder of tooth eruption, can often be found with more than one different variation in a child. The objective of this study was to assess the prevalence and severity of infraocclusion and to investigate the selected dental variations associated with infraocclusion in the West Mediterranean region of Turkey.

METHODS: The sample consisted of 3,228 children aged 7-11 years. The prevalence and severity of infraocclusion and presence of other dental variations (tooth agenesis, supernumerary teeth (ST), dens invaginatus, and taurodontism) were determined by the examination of panoramic radiographies. The development degree of the corresponding permanent teeth was determined using the Nolla and Haavikko method. For statistical testing, the chi-square test was used to compare the data in SPSS software.

RESULTS: Infraocclusion was defined in 3.25% of the examined primary molars. There was no statistically significant difference in the prevalence of infraocclusion between girls (n = 51) and boys (n = 73) or between the right and left sides (P > 0.05). It was found that about half of the affected patients had two impacted molars. Infraocclusion had mainly affected the first mandibular molar. A dental variation was also found in addition to infraocclusion in 50.8% of the patients. It was observed that primary molars without successors had more severe infraocclusion. No difference in terms of tooth development was detected (P > 0.05).

CONCLUSION: Given the results of the present study, it was seen that half of the children with infraoccluded primary molar had additional dental variations. Therefore, all children in the mixed and primary dentition must be examined carefully for the infraocclusion of primary molars and accompanying dental variations. Early diagnosis and treatment may prevent the development of complications, so that the condition can be appropriately managed.

KEYWORDS: Child; Prevalence; Primary Tooth; Tooth Abnormalities; Tooth Eruption

Citation: Ciftci ZZ, Kirzioglu Z, Saritekin A. **Prevalence of infraocclusion in primary molars and accompanying dental variations in a Turkish sample.** J Oral Health Oral Epidemiol 2021; 10(3): 128-33.

Infraocclusion is used to describe the teeth positioned below the level of the occlusal plane and can be seen in both primary and permanent dentition. Teeth can be impacted to different levels as compared to the adjacent teeth's occlusal plane. Terms such as submerged teeth, ankylosed teeth, secondary retention, impacted tooth, and incomplete tooth eruption can also be employed for this situation in the literature.¹⁻³ This ambiguity exists because the etiological factors that lead to the disorder are not clearly understood.

It is reported that both genetic and environmental factors play a role in the etiology, pattern of expression, and the degree of severity of infraocclusion.^{2,4,5} The genetic transition of infraocclusion can be supported by the high incidence rates in monozygotic twins.^{6,7} Other local factors associated with infraocclusion are chemical or thermal irritation, local metabolic disorders, trauma, congenital absence of permanent teeth, lack of space, disorders of the periodontal ligament, injuries of the periodontal ligament, permanent primary molars that have erupted

1- Assistant Professor, Department of Pediatric Dentistry, School of Dentistry, Akdeniz University, Antalya, Turkey

2- Professor, Department of Pediatric Dentistry, School of Dentistry, Suleyman Demirel University, Isparta, Turkey

3- Specialist, Antalya Oral and Dental Health Center, Antalya, Turkey

Address for correspondence: Zulfikar Zahit Ciftci PhD; Assistant Professor, Department of Pediatric Dentistry, School of Dentistry, Akdeniz University, Antalya, Turkey; Email: zzahitciftci@gmail.com

early, and defective eruption strength.⁸⁻¹⁰ Moreover, there exist studies stating that ankylosis within local factors is the principal factor in infraocclusion.^{11,12} Metabolic disorders in periodontal tissues result in ankylosis, causing teeth to remain in an infraoccluded position.⁹

Reports reveal that the prevalence of infraocclusion in the primary dentition range between 1.3% and 32.0%.^{7,13,14} Infraocclusion, which is frequently observed in patients aged between 8 and 9 years, affects both genders equally. It has been reported that the prevalence of infraocclusion was higher in mandibular teeth than in maxillary teeth, and higher in the primary first molars than in primary second molars.^{7,14,15}

Children with one infraoccluded tooth frequently have infraocclusion in their other teeth, and there will be often more than one different variation in a child with infraocclusion.^{6,16} As the prevalence of infraocclusion in patients with other dental variations is higher than infraocclusion alone in the general population, an increased prevalence of dental variations such as agenesis, palatally displaced canines (PDC), and small maxillary lateral incisors has also been reported.¹⁶⁻¹⁸

The prevalence of infraocclusion and accompanying dental variations appears to differ according to population group. Therefore, the aim of this study was to define the prevalence and severity of infraocclusion in primary teeth, as well as the relation between permanent teeth and the presence of dental variations accompanying infraocclusion in the West-Mediterranean region of Turkey.

Methods

This was a retrospective cross-sectional study that was reviewed and approved by the ethics committee of the School of Medicine, Suleyman Demirel University, Isparta, Turkey (25.09.2013/193).

The sample was retrieved from the clinical files of patients aged between 7 and 11 years attending to the Department of Pediatric Dentistry (Faculty of Dentistry, Suleyman

Demirel University) requesting dental treatment, between 2003 and 2015. Patients with incomplete records, without parental informed consent, poor quality radiographies, systemic problems or growth retardation, inappropriate tooth development given their ages, trauma, high decay incidence, ectopic eruption problems, and infra position due to the lack of space were excluded from the study. In total, 4236 records were evaluated and 3228 patients presenting the defined criteria were selected for the study.

The level of primary molars located below the occlusal plane was determined by the examination of panoramic radiographies and the gender, prevalence of infraocclusion, distribution to jaws and teeth, and whether infraoccluded teeth had successor permanent teeth were recorded from the patient records. The severity of infraocclusion was determined based on the Brearley's classification.¹⁹

Dental variations accompanying infraocclusion were also recorded, including agenesis, supernumerary teeth (ST), dens invaginatus, and taurodontism. Evaluation was performed to examine whether infraoccluded teeth had successor permanent teeth. In addition, Nolla and Haavikko dental age estimation systems, which utilize the maturation of teeth for age assessment, were used to evaluate the developmental stage of successor permanent teeth under infraoccluded primary molars and the symmetrical teeth to these teeth.^{20,21} Each tooth was scored according to their development level using the diagrams of these systems. All evaluations were carried out by two authors who were pediatric dentists (ZZC and AS).

The data were subsequently processed and analyzed using SPSS statistical software (version 17.0, SPSS Inc., Chicago, IL, USA). Before commencing the study, in pursuit of training and calibration for methods, 40 randomly selected radiographs were classified twice at different times by each of the authors. Inter-rater reliability was assessed using Cohen's Kappa test. Chi-square tests were carried out to compare the frequency of

occurrence and degree of expression.

Results

Cohen's kappa statistic demonstrated substantial inter-rater reliability between the examiners (Kappa = 0.92); no significant errors were found between the two analyses.

Records of 1808 boy (56.0%) and 1420 girl (44.0%) patients between 7 and 11 years (9.80 ± 1.26) of age, 3228 in total, were examined. One or more infraoccluded primary molars were found in 124 patients (3.84%). It was observed that 73 (59.0%) and 51 (41.0%) of the patients with infraoccluded primary molar were boys and girls, respectively. There was no significant difference in the prevalence of infraocclusion between boys and girls ($P > 0.05$).

Infraocclusion was defined in 3.25% of the primary molars examined. It was found that in the patients with infraocclusion, 1 tooth was infraoccluded in 45.2%, 2 teeth in 47.6%, 3 teeth in 3.2%, and four or more teeth in 4.0% of the patients (Figure 1).

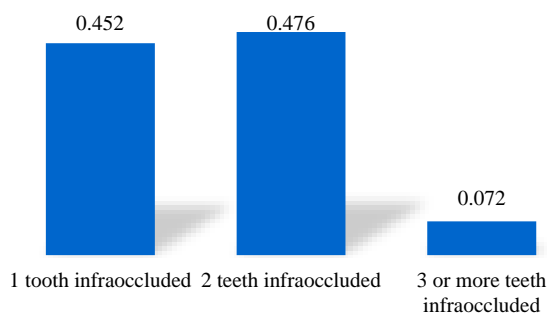


Figure 1. Patient distribution according to the number of infraoccluded teeth

An evaluation was performed to determine the primary teeth affected by

infraocclusion. The prevalence of infraocclusion was found 8.57% in maxilla and 91.43% in mandible. Percentage distribution of the teeth is shown in figure 2.

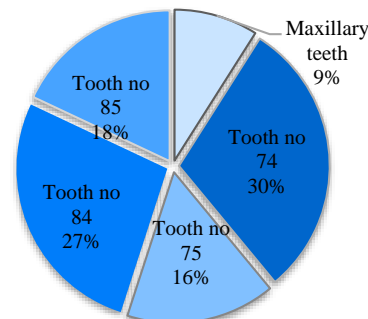


Figure 2. Distribution of infraoccluded primary molar teeth

Given the data, infraoccluded primary molars consisted of 61% and 39% first and second primary molars, respectively. Additionally, it was found out that the prevalence of infraocclusion within the mandibular primary molars was 10.1 times higher than within the maxillary primary molars. A difference in the prevalence of infraocclusion was not observed between the right and left regions of the jaws ($P > 0.05$).

Radiographies were recorded based on age and the infraocclusion severity was evaluated using Brearley's classification. The distribution of infraocclusion level within patients between 7 and 11 years old is shown in figure 3.

The prevalence of other dental variations within patients who have infraoccluded primary molars was also evaluated. A dental variation was also found in addition to infraocclusion within 50.8% of the patients. The frequency of dental situations accompanying infraocclusion is shown in table 1.

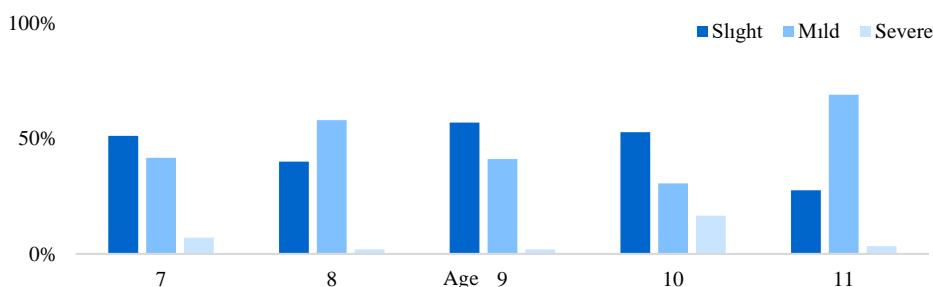


Figure 3. Distribution of severity of infraoccluded teeth according to age

Table 1. Distribution of dental variations accompanying infraocclusion

Dental variations	Prevalence rate (%)
Agenesis	703 (21.78)
Dens invaginatus	677 (20.97)
Taurodontism	182 (5.64)
ST	78 (2.42)

ST: Supernumerary teeth

Comparing the infraoccluded primary molars without successors with the infraoccluded primary molars with successors, it was observed that the primary molars without successors had more severe infraocclusion (Figure 4).

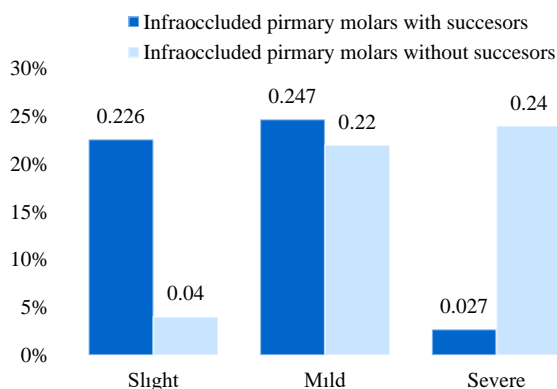


Figure 4. Severity of infraocclusion of primary teeth with and without successors

Successor permanent tooth under infraoccluded tooth and symmetric permanent tooth under non-infraoccluded primary molar were evaluated via two different systems and no difference in terms of tooth development was detected ($P > 0.05$).

Discussion

Genetic and local factors play a role in the etiology of infraocclusion.^{5,10} Infraocclusion was observed in the same primary molars of identical twins in our study group, signaling potential genetic factors of infraocclusion. Local factors that cause infraocclusion in primary teeth can generally be associated with congenitally missing teeth. It was also observed that the infraocclusion level became more severe within infraoccluded primary teeth without successor teeth.

In various studies, the prevalence of

infraocclusion in primary teeth has been reported as 1.3-32.0%.^{7,13,14} These findings vary in different populations due to the influence of different environmental factors, dietary habits, growth rates, and ethnicities. The differences in the study design such as age, study sample size, diagnostic method, and variance in the inclusion or exclusion criteria may account for this extensive range of study results.²² The methods used to identify and assess the severity of infraocclusion, such as direct visual examination, the measurement on radiographs, or the measurement of dental models may also differ. In this study, the rate was defined as 3.8% on a patient basis and 3.25% on a tooth basis.

Overall, infraocclusion affects predominantly mandibular molars up to 27 times more according to the study by Odeh et al.⁷ Our study found that the prevalence rate of infraocclusion was 10 times higher in the mandibular molars than the maxillary molars. Similarly, in another study, it was stated as 10 times higher too.²³

Contrary to those researchers who asserted that primary first molars were the most affected in studies to define which primary teeth were affected by infraocclusion,^{7,14,24} other researchers stated that mandibular primary second molars were the primarily affected ones.^{19,25} In this study, the ratio of the infraoccluded primary first molars to the primary second molars was found to be 1.68. It has been reported that this difference may be due to a later exfoliation of the second molar.¹⁴

The distance between respective occlusal surfaces in primary molar teeth vary according to the severity of infraocclusion. It was reported that the prevalence of severe infraocclusion in primary teeth varied from 2.5%-25.0%.^{18,19} In our study, it was found that 12% of primary molars were affected by severe infraocclusion, consistent with findings reported previously.^{14,24} In addition, it was observed that the severity of infraocclusion increased with age. Cardoso et al.¹⁴ stated that there may be an increase in

infraocclusion severity due to an alteration in the normal growth of the alveolar apophysis.

Children with one infraoccluded tooth can frequently have infraocclusion in additional teeth. We found that the frequency of patients with 2 and 1 infraoccluded molars was 47.60 and 45.20%, respectively, similar to the findings of Raducanu and Feraru.²⁴ Researchers found that ratios as 52.63% and 42.10%, respectively.²⁴ When a child presents with an infraoccluded primary molar tooth, he/she must be regularly reviewed for infraocclusion at other sites. McGeown and O'Connell²⁶ point out that the number of infraoccluded teeth can affect the decision to extract the teeth or monitor the patient, as having multiple infraoccluded teeth can increase space loss or play a part in patient management if multiple extractions are required.

It has been stated that, in the presence of infraoccluded primary molars, successor permanent teeth may also be affected, and a delay in development can occur in those teeth.⁶ Therefore, our study also examined the development of successor permanent teeth under infraoccluded teeth and symmetric permanent teeth. We used two different systems to eliminate any disparity between methods. No differences were found among the development levels of the underlying permanent teeth, however the evaluation was carried out only on the successor permanent teeth.

Dental variations within the children were generally accompanied by other problems. In this study, it was determined that other dental variations can also be seen in the presence of infraocclusion, and that the most frequently observed variation was the agenesis of any permanent teeth (21.78%), followed by dens invaginatus (20.97%), ST (5.64%), and taurodontism (2.42%). An additional dental problem was seen in 50.8% of the patients having infraoccluded primary molar. Especially, the prevalence of agenesis

was higher than that reported in previous studies.^{6,14} It was also observed that the primary molars without successors had more severe infraocclusion.

In this study, the magnitude of infraocclusion was visually classified on the panoramic radiographs. The lack of quantitative measurements can be regarded as one of the limitations of our work. Another limitation of this study was the limited age range. Especially, in order to evaluate the changes in severity of infraocclusion with age, studies including study samples with a wider age range should be conducted.

Conclusion

The findings of this study indicated that other dental variations can be seen in children with an infraoccluded tooth, and that infraocclusion is often seen in several teeth rather than a single tooth. Therefore, since early diagnosis and treatment may prevent the development of complications, all children with primary and mixed dentition should be examined for infraocclusion at routine dental visits and if detected, the remaining teeth should be monitored for infraocclusion and other tooth variations. Especially, the presence and development of permanent successor teeth under infraoccluded primary molars must be controlled as infraocclusion is most frequently associated with congenitally missing teeth. Considering that infraoccluded primary molars can be ankylosed, any course of treatment to support alveolus bone development should be undertaken during the earliest possible stages.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

The authors were not supported by any organization

References

1. Uloopi KS, Madhuri V, Gopal AS, Vinay C, Chandrasekhar R. Multiple unerupted permanent teeth associated with noonan syndrome. *Ann Med Health Sci Res* 2015; 5(4): 317-20.

2. Frazier-Bowers SA, Puranik CP, Mahaney MC. The etiology of eruption disorders - further evidence of a 'genetic paradigm'. *Semin Orthod* 2010; 16(3): 180-5.
3. de Moura MS, Pontes AS, Brito MH, de Deus ML, de Deus Moura de Lima, de Melo Simplicio AH. Restorative management of severely ankylosed primary molars. *J Dent Child (Chic)* 2015; 82(1): 41-6.
4. Garcovich D, Aiuto R, Martin MA. Space regaining made easy: The case of a severely infraoccluded primary molar. *Case Rep Dent* 2019; 2019: 6916839.
5. Tong A, Chow YL, Xu K, Hardiman R, Schneider P, Tan SS. Transcriptome analysis of ankylosed primary molars with infraocclusion. *Int J Oral Sci* 2020; 12(1): 7.
6. Odeh R, Townsend G, Mihailidis S, Lahdesmaki R, Hughes T, Brook A. Infraocclusion: Dental development and associated dental variations in singletons and twins. *Arch Oral Biol* 2015; 60(9): 1394-402.
7. Odeh R, Mihailidis S, Townsend G, Lahdesmaki R, Hughes T, Brook A. Prevalence of infraocclusion of primary molars determined using a new 2D image analysis methodology. *Aust Dent J* 2016; 61(2): 183-9.
8. Antoniadis K, Kavadia S, Milioti K, Antoniadis V, Markovitsi E. Submerged teeth. *J Clin Pediatr Dent* 2002; 26(3): 239-42.
9. Nirmala SV, Sandeep C, Sivakumar N, Babu MS, Lalitha V. Agenesis of premolar associated with submerged primary molar and a supernumerary premolar: An unusual case report. *Contemp Clin Dent* 2012; 3(Suppl 1): S99-S102.
10. Arhakis A, Boutiou E. Etiology, diagnosis, consequences and treatment of infraoccluded primary molars. *Open Dent J* 2016; 10: 714-9.
11. Proffit WR, Frazier-Bowers SA. Mechanism and control of tooth eruption: overview and clinical implications. *Orthod Craniofac Res* 2009; 12(2): 59-66.
12. Cobourne MT, Sharpe PT. Diseases of the tooth: The genetic and molecular basis of inherited anomalies affecting the dentition. *Wiley Interdiscip Rev Dev Biol* 2013; 2(2): 183-212.
13. Via WF. Submerged deciduous molars: Familial tendencies. *J Am Dent Assoc* 1964; 69: 127-9.
14. Cardoso SC, Maroto EM, Soledad Alvaro LM, Barberia LE. Primary molar infraocclusion: Frequency, magnitude, root resorption and premolar agenesis in a Spanish sample. *Eur J Paediatr Dent* 2014; 15(3): 258-64.
15. Peretz B, Absawi-Huri M, Bercovich R, Amir E. Inter-relations between infraocclusion of primary mandibular molars, tipping of adjacent teeth, and alveolar bone height. *Pediatr Dent* 2013; 35(4): 325-8.
16. Al-Abdallah M, AlHadidi A, Hammad M, Al-Ahmad H, Saleh R. Prevalence and distribution of dental anomalies: A comparison between maxillary and mandibular tooth agenesis. *Am J Orthod Dentofacial Orthop* 2015; 148(5): 793-8.
17. Baccetti T. A controlled study of associated dental anomalies. *Angle Orthod* 1998; 68(3): 267-74.
18. Shalish M, Peck S, Wasserstein A, Peck L. Increased occurrence of dental anomalies associated with infraocclusion of deciduous molars. *Angle Orthod* 2010; 80(3): 440-5.
19. Brearley LJ, McKibben DH. Ankylosis of primary molar teeth. I. Prevalence and characteristics. *ASDC J Dent Child* 1973; 40(1): 54-63.
20. Nolla CM. The development of permanent teeth. *J Dent Child* 1960; 27: 254-66.
21. Haavikko K. The formation and the alveolar and clinical eruption of the permanent teeth. An orthopantomographic study. *Suom Hammaslaak Toim* 1970; 66(3): 103-70.
22. Kurol J. Infraocclusion of primary molars: An epidemiologic and familial study. *Community Dent Oral Epidemiol* 1981; 9(2): 94-102.
23. Kurol J, Thilander B. Infraocclusion of primary molars with aplasia of the permanent successor. A longitudinal study. *Angle Orthod* 1984; 54(4): 283-94.
24. Raducanu AM, Feraru V. Reimpaction of primary molars - epidemiological study, clinical cases. *Oral Health Dent Manag* 2005; 4(2): 28-35.
25. Shalish M, Har-Zion G, Zini A, Harari D, Chaushu S. Deep submersion: Severe phenotype of deciduous-molar infraocclusion with biological associations. *Angle Orthod* 2014; 84(2): 292-6.
26. McGeown M, O'Connell A. Management of primary molar infraocclusion in general practice. *J Ir Dent Assoc* 2014; 60(4): 192-8.