Causes and patterns of permanent tooth loss among 9-15 years old children in the Central Anatolia Region

Merve Candan DDS, PhD[1] , *Esra Mavi DDS, PhD[2]* , *Burak Buldur DDS, PhD[3]*

Original Article

Abstract

BACKGROUND AND AIM: The aim of this study was to investigate the causes and patterns of permanent tooth extraction among a subpopulation of 9-15-year-old Turkish children.

METHODS: This study employed a retrospective design and consisted of a total of 198 children aged 9 to 15 years attending a dental faculty between January and December 2019. The clinical and radiographic data were obtained from the medical and dental forms from the faculty database. The inclusion criteria included having at least one permanent tooth loss. Age, gender, the Decayed, Missing, and Filled Teeth (DMFT) scores, type and localization of missing permanent tooth/teeth, and reasons for the loss were evalauted. The data were analyzed using descriptive statistics and chi-square test at 0.05 significance level.

RESULTS: A total of 198 patients with 309 extracted teeth were evalauted. The mean age of the subjects was 12.95 ± 1.58 years and mean DMFT score was 6.25 ± 3.52. Extractions for orthodontic needs (41.7%) and caries-related extractions (32.4%) were the most common causes of tooth loss followed by unsuccessful dental treatments in 13.9% of cases. While the highest DMFT scores were found in dental caries and orthodonic needs groups, the less scores were found in the "others" group. The most frequently extracted teeth due to caries were the first molar teeth and the first mandibular molars were mostly extracted compared to maxillar first molars. The most frequently extracted teeth due to orthodontic needs and dental caries were seen in girls.

CONCLUSION: Orthodontic needs and dental caries were found to be the main causative factors for permanent tooth extractions.

KEYWORDS: Child; Dental Caries; Tooth; Tooth Loss

Dental pain and tooth loss can occur by poor oral health;[1] even there is evidence of connection with systemic diseases.[2,3] Previous studies have reported that dental caries and periodontal diseases are the most common pathologies affecting the oral cavity,[4-6] and the major causes of tooth loss are due to dental caries in early period of adultness[7-9] and periodontal disease in elderly patients.[10,11]

Permanent tooth loss is an important varibale used to evaluate community oral health status.[12-15] The loss of permanent teeth occurs due to various reasons, including dental caries, orthodontic needs, unsuccessful dental treatments, indications for dentures, and other causes.[16-20] In addition to problems related to social relations in patients, tooth loss causes mastication, speech, nutritional, and psychological problems and aesthetic concerns.[21-23]

Understanding the reasons for the extraction of the permanent teeth enables us to improve oral health outcomes. It is important to identify the main rationales for tooth extraction which enables us to limit tooth extractions and emphasize the critical role of preventing tooth extraction. The

1- Research Assistant, Department of Pediatric Dentistry, School of Dentistry, Cumhuriyet University, Sivas, Turkey
2- Assistant Professor, Department of Oral and Maxillofacial Surgery, School of Dentistry, Cumhuriyet University, Sivas, Turkey
3- Associate Professor, Department of Pediatric Dentistry, School of Dentistry, Cumhuriyet University, Sivas, Turkey
Address for correspondence: Burak Buldur DDS, PhD; Associate Professor, Department of Pediatric Dentistry, School of Dentistry, Cumhuriyet University, Sivas, Turkey; Email: bbuldur@gmail.com

present study had three research questions: i) What are the dynamics of permanent tooth loss over time? ii) Is permanent tooth loss associated with gender or Decayed, Missing, and Filled Teeth (DMFT) scores? iii) Is there a relationship between the reason for extraction and the type or localization of the permanent teeth lost? This study aimed to evaluate the causes of permanent tooth extraction, their relationship with various variables such as age, gender, and DMFT score, and the reasons and prevalence for permanent tooth extraction among 9-15-year old children in a Turkish subpopulation.

Methods

The study followed the ethical standards specified in the 1975 Declaration of Helsinki (revised in 2000) and its subsequent amendments. Written informed consent was obtained from participants.

The study group consited of 9 to 15-year-old patients who had at least one permanent tooth extraction and applied to School of Dentistry, Cumhuriyet University, Sivas, Turkey, between January 2019 and December 2019. Patients with any congenital and/or systemic diseases were excluded from the study. Radiographical and clinical records of patients were evaluated retrospectively. The data were gathed under the following categories: gender, age, DMFT scores, and reasons for extraction. The reasons for tooth extractions were listed in the following subheadings: dental caries, unsuccessful dental treatment, dental trauma, periodontal problems, eruption problems, orthodontic needs, and other reasons (patient's collaboration and patient and parental attitude towards dental treatment). Data were evaluated by two calibrated and trained observers and inter-observer agreement was found to be good (Cronbach's alpha = 0.91).

Statistical analyses were performed using SPSS software (version 22, IBM Corporation, Armonk, NY, USA). Descriptive analyses, namely including frequencies and percentage, were used to summarize the demographic characteristics. The distribution of extracted tooth according to gender, dentition type, and tooth type was analyzed by the chi-square test. The significance level was 0.05.

Results

Of the patients, 57.9% (n = 179) were girls and 42.1% (n = 130) were boys. The average age of the subjects was 12.95 ± 1.58 (mininum = 9.0, maximum = 14.9). Mean DMFT score of the subjects was 6.25 ± 3.52 (minimum = 1, maximum = 18).

Figure 1 presents the distribution of extracted teeth according to dentition type. With regard to dentition type, tooh loss was mostly observed in permanent dentition due to dental caries, orthodontic treatment, and eruption problems. While permanent tooth loss due to dental caries was mostly seen in boys, orthodontic needs were mostly observed in girls. Whereas first permanent molar teeth were mostly extracted due to dental caries, first permanent premolar teeth were mostly extracted for orthodontic reasons. Incisors were the most subjected teeth to dental trauma and eruption problems.
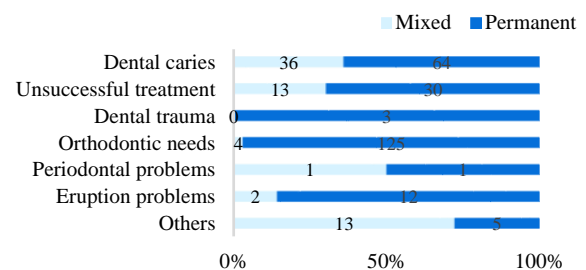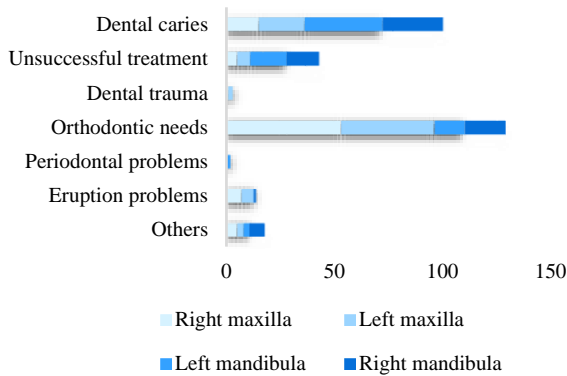

Figure 1. Numbers of extracted teeth according to dentition type

Figure 2 presents the distribution of extracted teeth according to localization in the jaw. Tooth loss due to dental caries and unsuccessful treatment was mostly seen in mandible and loss due to orthodontic needs were mostly seen in maxilla. Tooth loss due to dental trauma and eruption problems was mostly observed in maxilla. Table 1 presents the descriptive statistics of tooth extraction reasons by age. The highest mean age was found in orthodontic needs group.

Table 1. Descriptive statistics of tooth extraction reasons by age

	n (%)	Mean ± SD	95% CI
Dental caries	100 (32.36)	12.30 ± 1.54	11.99-12.61
Unsuccessful treatment	43 (13.92)	12.29 ± 1.64	11.79-12.80
Dental trauma	3 (0.97)	13.33 ± 0.12	13.05-13.62
Orthodontic needs	129 (41.75)	13.94 ± 0.98	13.79-14.08
Periodontal problems	2 (0.65)	11.50 ± 1.32	2.61-20.39
Eruption problems	14 (4.53)	13.19 ± 0.17	12.42-13.95
Others	18 (5.83)	11.03 ± 1.58	10.16-11.96

SD: Standard deviation; CI: Confidence interval

Figure 2. Numbers of extracted teeth according to localization in the jaw

Table 2 presents the descriptive statistics of tooth extraction reasons by DMFT scores. While the highest DMFT scores were found in dental caries and orthodonic needs groups, the less scores were found in the "others" group. There were statistically significant differences among dental caries and orthodontic needs compared to the other groups (P = 0.024).

Figure 3 presents the numbers of extracted teeth according to tooth type. The most frequently extracted teeth due to caries were the first molar teeth and the first mandibular molars were mostly extracted compared to maxillar first molars. While first molar teeth were mostly extracted due to unsuccessful

treatment and other reasons, incisors were mostly extracted due to dental trauma and eruption problems. While first premolar teeth were mostly extracted due to orthodontic reasons, maxillary first premolar teeth were more extracted than mandibular first premolar teeth.
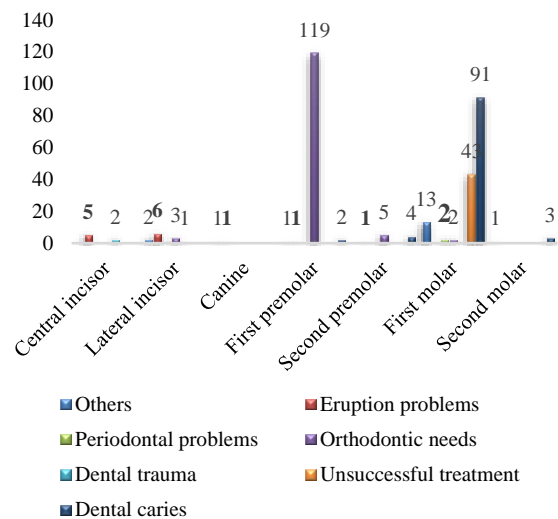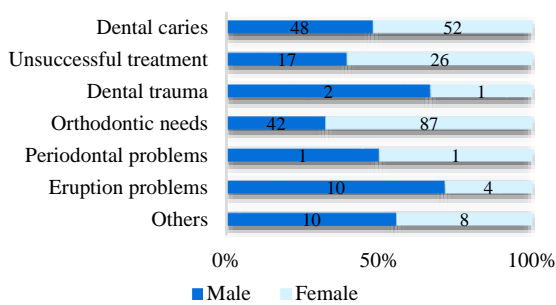

Figure 3. Numbers of extracted teeth according to tooth type

Figure 4 presents the distribution of extracted teeth according to sex. The most frequently extracted teeth due to orthodontic needs and dental caries were seen in girls.

Table 2. Descriptive statistics and comparison of reasons for tooth extraction by Decayed, Missing, and Filled Teeth (DMFT) scores

	n (%)	Mean ± SD	Minimum	Maximum
Dental caries	100 (32.36)	7.23 ± 3.95	1.00	17.00
Unsuccessful treatment	43 (13.92)	5.14 ± 2.67	1.00	11.00
Dental trauma	3 (0.97)	5.33 ± 1.83	2.00	7.00
Orthodontic needs	129 (41.75)	6.50 ± 5.89	0	18.00
Periodontal problems	2 (0.65)	6.00 ± 19.41	4.00	8.00
Eruption problems	14 (4.53)	4.14 ± 1.75	2.00	9.00
Others	18 (5.83)	3.61 ± 1.34	1.00	7.00

SD: Standard deviation

Figure 4. Numbers of extracted teeth according to sex

Extractions for orthodontic needs (41.7%) and caries-related extractions (32.4%) were the most common causes of tooth loss followed by unsuccessful dental treatments in 13.9% of cases.

Discussion

Factors including dental pain, parental attitudes, child's ability to tolerate dental treatment under local anesthesia, unsuccessful root canal treatments, periodontal and eruption problems, apical pathologies, and orthodontic treatments are indicative for decision of extracting or treating permanent teeth.[7,24,25] The findings revealed that dental caries and orthodontic needs were the main reasons for permanent tooth extractions.

Tooth extraction is a commonly used treatment method in orthodontic patients.[26-28] The decision of tooth extraction for orthodontic treatment is decided for reasons such as oral hygiene, carious or impacted teeth, periodontal disease, supernumerary teeth, and hypodontics or orthognathic surgery. Planning tooth extraction for orthodontic treatment is one of the important factors for functional and aesthetic orthodontic results and treatment's long-term stability.[29] Orthodontic need was the main reason for tooth extraction in 41.7% of cases. In addition, girls had slightly more extracted teeth than boys, and the most extracted tooth was the first premolar tooth. The frequency of tooth extraction related to orthodontic needs was more common in girls; thus, it is important to demonstrate the gender-related

difference of orthodontic treatment-related tooth loss. This finding of the present study may be due to the having higher aesthetic concerns of girls compared to boys.[30]

The permanent first molars have higher risk of dental caries in the years following their eruption.[31] The majority of the teeth extracted due to dental caries were permanent first molars. These results are compatible with a previous study reporting that caries rate of permanent first molars is quite high in 18-year-old individuals and this tooth has an important effect in increasing overall DMFT values. Demirbuga et al. reported the ratio of caries, filled, and extracted teeth to total teeth as 15.8% among a subgroup of 13-16-year old patients.[32] The first permanent molars are more subject to dental caries and early extraction due to their early eruption. Meneghel et al. reported that higher food retantion occured on the surface of mandibular teeth than maxillary teeth.[33] The maxillary permanent first molar teeth have less caries and/or fillings than the mandibular permanent first molar teeth. This may be due to cleaning effect of the salivary gland duct opening to the buccal surface of these teeth.[34] Mandibular teeth were reported to be less carious and/or filled than maxillar teeth. However, this situation is different for permanent first molars and it has been reported that more caries and/or fillings are observed in the mandibular permanent first molars. In accordance with literature, present study showed that the most frequently extracted teeth due to caries were the first molar teeth, and the mandibular first molars were more extracted than maxillary first molars.

Permanent second molar teeth should be critically evaluated before permanent first molar teeth extraction since it may be possible to close the space spontaneously after tooth extraction and to properly align the permanent teeth.[35,36] The extraction of permanent first molars does not cause major problems in maxilla but the effect of this loss is significant in mandible. Occlusion also depends on the extraction age, and the best results occur at an early age (8-10 years).

The average age for extraction of the permanent first molar teeth was found to be 12.01 years, which is beyond the commonly recommended extraction age (8-10 years).

In the present study, causes such as the severity of dental pain, the child's dental anxiety and ability to tolerate long dental treatment under local anesthesia, parental attitudes towards dental orthodontic treatment, and rejection of treatment were gathered under "other reasons" category. These are among the reasons for permanent tooth extraction with a rate of 5.8% in this study. It is clear that in order to eliminate the above causes categorized in others group, which causes the dental treatment option to disappear, the motivation of the child should be increased and informative education should be provided for children and their parents.

This study has several limititons. First, the study sample was chosen from a single province, which may limit the generalisability of findings. Another limitation was relatively small sample size. Furher studies should be performed in larger samples and different centers.

Permanent first molars caries experience especially continues to be the best predictor of future caries in children.[33] Early permanent teeth loss due to dental caries gives us a prediction regarding the efficacy of oral health programs and common attitudes towards oral health.[10,19,23] With aiming to develop effective policy for reducing early permanent tooth extraction, it is necessary to determine the characteristics of tooth extraction in children according to their causes. Considering that this is the first study to explore the causes of tooth loss in children living in Sivas Province, the current retrospective study can be useful in clinical dentistry and can be used as basic data on the frequency and causes of tooth extraction in other populations.

Conclusion

Within the limitations, this study revealed that orthodontic needs and dental caries were found to be the primary reasons of permanent tooth extraction in a Turkish subpopulation. Children who apply to the dentist for permanent first molar extraction tend to be older than the most appropriate age reported for space closure after extraction. Therefore, dentists can use a series of guides that specify when to direct patients for the extraction of permanent first molar teeth.

This study also emphasizes the need for comprehensive prevention programs for children at high risk of caries and the need to increase preventive treatments for the protection of permanent teeth in children. Preventive programs should be implemented to reduce tooth extraction caused by causes discussed in the study.

Conflict of Interests

Authors have no conflict of interest.

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References

1. Buldur B. Pathways between parental and individual determinants of dental caries and dental visit behaviours among children: Validation of a new conceptual model. Community Dent Oral Epidemiol 2020; 48(4): 280-7.
2. Hopcraft MS, Beaumont S. The growing problems of dental caries and obesity: An Australian perspective. Br Dent J 2016; 221(7): 379-81.
3. Cigerim L, Feslihan E. The effect of body mass index on blood pressure and heart rate in patients undergoing tooth extraction. J Oral Health Oral Epidemiol 2019; 8(4): 177-82.
4. Buldur B, Guvendi ON. Conceptual modelling of the factors affecting oral health-related quality of life in children: A path analysis. Int J Paediatr Dent 2020; 30(2): 181-92.
5. Frencken JE, Sharma P, Stenhouse L, Green D, Laverty D, Dietrich T. Global epidemiology of dental caries and severe periodontitis - a comprehensive review. J Clin Periodontol 2017; 44(Suppl 18): S94-S105.
6. Hujoel PP, Lingstrom P. Nutrition, dental caries and periodontal disease: A narrative review. J Clin Periodontol 2017; 44(Suppl 18): S79-S84.
7. Monte-Santo AS, Viana SVC, Moreira KMS, Imparato JCP, Mendes FM, Bonini GAVC. Prevalence of early loss of

primary molar and its impact in schoolchildren's quality of life. Int J Paediatr Dent 2018; 28(6): 595-601.

8. George B, John J, Saravanan S, Arumugham IM. Prevalence of permanent tooth loss among children and adults in a suburban area of Chennai. Indian J Dent Res 2011; 22(2): 364.

9. Candan M, Buldur B. Primary tooth extraction pattern among turkish children with severe early childhood caries treated under general anesthesia. Pesqui Bras Odontopediatria Clin Integr 2020; 20(3): e5382.

10. Nilsson H, Sanmartin BJ, Renvert S. Longitudinal evaluation of periodontitis and tooth loss among older adults. J Clin Periodontol 2019; 46(10): 1041-9.

11. Nilsson H, Berglund JS, Renvert S. Periodontitis, tooth loss and cognitive functions among older adults. Clin Oral Investig 2018; 22(5): 2103-9.

12. Haworth S, Shungin D, Kwak SY, Kim HY, West NX, Thomas SJ, et al. Tooth loss is a complex measure of oral disease: Determinants and methodological considerations. Community Dent Oral Epidemiol 2018; 46(6): 555-62.

13. Silva Junior MF, Batista MJ, de Sousa MDLR. Risk factors for tooth loss in adults: A population-based prospective cohort study. PLoS One 2019; 14(7): e0219240.

14. Hassel AJ, Safaltin V, Grill S, Schroder J, Wahl HW, Klotz AL, et al. Risk factors for tooth loss in middle and older age after up to 10 years: An observational cohort study. Arch Oral Biol 2018; 86: 7-12.

15. Kazemi Karyani A, Habibullah Pulok M, Ahmadi S, Soltani S, Kazemi Z, Homaie Rad E, et al. What explains socioeconomic inequality in dental caries among school children in west of Iran? A Blinder-Oaxaca decomposition. J Oral Health Oral Epidemiol 2019; 8(3): 153-60.

16. Anand PS, Kuriakose S. Causes and patterns of loss of permanent teeth among patients attending a dental teaching institution in south India. J Contemp Dent Pract 2009; 10(5): E057-64.

17. Oginni FO. Tooth loss in a sub-urban Nigerian population: causes and pattern of mortality revisited. Int Dent J 2005; 55(1): 17-23.

18. Sanya BO, Ng'ang'a PM, Ng'ang'a RN. Causes and pattern of missing permanent teeth among Kenyans. East Afr Med J 2004; 81(6): 322-5.

19. Murray H, Locker D, Kay EJ. Patterns of and reasons for tooth extractions in general dental practice in Ontario, Canada. Community Dent Oral Epidemiol 1996; 24(3): 196-200.

20. Torabi-Parizi M, Karimi-Afshar M, Mashayekhi F, Karimi-Afshar M, Aminian A. Correlation between dental aesthetic index and orthodontics-related quality of life among students in south-east of Iran. J Oral Health Oral Epidemiol 2020; 9(1): 16-23.

21. Gerritsen AE, Allen PF, Witter DJ, Bronkhorst EM, Creugers NH. Tooth loss and oral health-related quality of life: A systematic review and meta-analysis. Health Qual Life Outcomes 2010; 8: 126.

22. Brennan DS, Spencer AJ, Roberts-Thomson KF. Tooth loss, chewing ability and quality of life. Qual Life Res 2008; 17(2): 227-35.

23. Saintrain MV, de Souza EH. Impact of tooth loss on the quality of life. Gerodontology 2012; 29(2): e632-e636.

24. Anbarserri NM, Ismail KM, Anbarserri H, Alanazi D, AlSaffan AD, Baseer MA, et al. Impact of severity of tooth loss on oral-health-related quality of life among dental patients. J Family Med Prim Care 2020; 9(1): 187-91.

25. Poureslami P, Pouradeli S, Poureslami H, Shahrokhi E. Evaluation of health status of first permanent molar teeth among 12-year-old students in rural areas of south of Kerman, Iran, 2016. J Oral Health Oral Epidemiol 2017; 7(1): 33-8.

26. Dardengo CS, Fernandes LQ, Capelli JJ. Frequency of orthodontic extraction. Dental Press J Orthod 2016; 21(1): 54-9.

27. Jackson TH, Guez C, Lin FC, Proffit WR, Ko CC. Extraction frequencies at a university orthodontic clinic in the 21st century: Demographic and diagnostic factors affecting the likelihood of extraction. Am J Orthod Dentofacial Orthop 2017; 151(3): 456-62.

28. Ebadifar A, Shafazand MH, Seifi M. Arch dimensional changes following orthodontic treatment with extraction of four first premolars. J Oral Health Oral Epidemiol 2016; 5(2): 84-9.

29. Al-Ani MH, Mageet A. Extraction planning in orthodontics. J Contemp Dent Pract 2020; 19(5): 619-23.

30. Alhammadi MS, Halboub E, Al-Mashraqi AA, Al-Homoud M, Wafi S, Zakari A, et al. Perception of facial, dental, and smile esthetics by dental students. J Esthet Restor Dent 2018; 30(5): 415-26.

31. Carvalho JC, Ekstrand KR, Thylstrup A. Dental plaque and caries on occlusal surfaces of first permanent molars in relation to stage of eruption. J Dent Res 1989; 68(5): 773-9.

32. Demirbuga S, Tuncay O, Cantekin K, Cayabatmaz M, Dincer AN, Kilinc HI, et al. Frequency and distribution of early tooth loss and endodontic treatment needs of permanent first molars in a Turkish pediatric population. Eur J Dent 2013; 7(Suppl 1): S099-S104.

33. Meneghel LL, Fernandes KBP, Lara SMH, Ferelle A, Sturion L, Walter LRF. Evaluation of food retention in occlusal surfaces of first primary molars. Int J Odontostomatol 2010; 4(2): 117-22.

34. Johansson I, Saellstrom AK, Rajan BP, Parameswaran A. Salivary flow and dental caries in Indian children suffering from chronic malnutrition. Caries Res 1992; 26(1): 38-43.

35. Teo TK, Ashley PF, Parekh S, Noar J. The evaluation of spontaneous space closure after the extraction of first permanent molars. Eur Arch Paediatr Dent 2013; 14(4): 207-12.

36. Shojaeipoor R, Horri A, Sharifi H, Mohseni S. Effect of extraction of permanent first molars on the development and eruption of third molars. J Oral Health Oral Epidemiol 2018; 7(3): 126-31.