<u>Original Article</u>

Prevalence of First Permanent Molar Loss in a Population of Saudi Adolescents and Young Adults

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Abstract
Aim: *The aim of this study was to detect the prevalence of first permanent molar loss in a population of Saudi adolescents and young adults in the Kingdom of Saudi Arabia and to investigate the reasons behind such loss.*
Materials and Methods: *252 Saudi patients aged (13-20) years who live in the Kingdom of Saudi Arabia were randomly selected and equally divided into two age groups: (13-16) years (17-20) years for the purpose of achieving comprehensive distribution. The study was carried out in the period February through April 2018. The patients were clinically examined for extracted or diagnosed for extraction first upper and lower permanent molars. In addition to clinical examination, panoramic radiographs were also used. The reason for extraction was documented whether by asking the patients why their tooth was extracted or by dental examination for the tooth diagnosed for extraction. The data obtained were documented in a patient examination form then statistically analyzed using Chi-Square Test.*
Results: *The prevalence of first permanent molar loss was detected to be (31.3%). A total of 79 patients (31.3%) presented with at least one first permanent molar loss*
(p=0.000<0.05). The total number of missing first permanent molars was (n=117 teeth), and there were more observations of first lower permanent molar loss (n=85 teeth) (72.6 %) than first upper permanent molar loss (n=32 teeth) (27.4%) (p=0.000< 0.05). Caries was the dominant reason for tooth loss.
Conclusion: *Early childhood preventive and dental education programs need to be implemented targeting caries and first permanent molars.*
Keywords: *First permanent molar loss, upper/maxillary, lower/mandibular, caries.*

Introduction

First Permanent Molars

First permanent molars usually erupt between age 6 and 7 years. For that reason, they are often called "six-year molars". They are among the permanent teeth that don't replace an existing deciduous (primary) tooth. These important teeth are sometimes mistaken for deciduous (primary) teeth. However, they are permanent and must be taken care of properly. The six-year molars also

help determine the shape of the lower face and affect the position and health of other permanent teeth.[1] In addition, the first permanent molars are called the first key of occlusion according to Andrews' six keys to normal occlusion. The first key is described as the molar relationship: The distal surface of the distobuccal cusp of the first upper permanent molar makes contact and occludes with the mesial surface of the mesiobuccal cusp of the second lower molar. The mesiobuccal cusp of the first upper permanent molar falls within the groove between the mesial and middle cusps of the first lower permanent molar (as sought by Angle).[2]

Materials and Methods
Ethical approval
The study was registered with the research center of Riyadh Elm University (FRP/2018/71) and received ethical approval from the institutional review board of the same institution (RC/IRB/2016/719).

Selection of the content for analysis and statistical analysis
252 Saudi patients aged (13-20) years who live in the Kingdom of Saudi Arabia were randomly selected and equally divided into two age groups: (13-16) years of age (17-20) years of age for the purpose of achieving comprehensive distribution. The study was conducted in the period February through April 2018. After taking the patient consent on an informed consent statement form

for clinical studies, the patients were clinically examined for extracted or diagnosed for extraction maxillary and mandibular first permanent molars. In addition to clinical examination, panoramic and periapical radiographs were used too. The reason for extraction including caries, periodontal disease, orthodontic, pre-prosthetic, trauma, and others was also documented whether by asking the patients why their tooth was extracted or by dental examination for the tooth diagnosed for extraction. The data obtained were documented in a patient examination form then statistically analyzed using Chi-Square Test (nonparametric statistics) to test the contingency of the variables. All statistical analyses were performed using the IBM SPSS Statistics version 20 data processing software. The significance level was set at $p < 0.05$.

Results:
The results of 252 patients were as follows:

I.   **Patients with and without molar loss**
For the purpose of the study, we tested the null hypothesis H_0 which stated that the percentages of patients with and without molar loss were equal at a confidence level 95%. Each observation of a patient with loss means that one patient lost upper or lower molars or upper and lower molars together.

Table 1 shows that the frequency of patients with loss was 79 observations (31.3%), and it was less than the frequency of patients without loss which was 173 observations (68.7%).

Table1: Loss by Patient Type Frequency and Percentages

Age group 13-20 years					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Patients with loss	79	31.3	31.3	31.3
	Patients without loss	173	68.7	68.7	100.0
	Total	252	100.0	100.0	

The question of this study: Were patients with loss and patients without loss observations distributed in equal proportions? In another word: Was the

difference in the percentages of patients with loss and patients without loss significant or insignificant? at a confidence level 95%.

To answer this question, we tested the null hypothesis H_0 versus the alternative hypothesis H_1 which stated that there was significant difference in the percentages of patients with loss and patients without loss.

Hypotheses:

H_0: p patients with loss $=$ p patients without loss $= ½$

H_1: p patients with loss $\neq$ p patients without loss $\neq 0$

Table 2: Loss by Patient Type Chi-Square Test / Frequencies

	Observed N	Expected N	Residual
Patients with loss	79	126.0	-47.0
Patients without loss	173	126.0	47.0
Total	252		

Table 2 shows the observed and the expected number of patients with and without loss. We used χ^2 Chi-Square Test to test the contingency (test of goodness of fit) of the observed and expected number of patients with and without loss. The expected number was equal for each of the two types of patients (126), and this what the null hypothesis stated. So, was the hypothesis accepted or not?

The answer came in table 3 which contains the results of the study test. For taking the decision, we recognized the following:

For degree of freedom df=1 and significance level of this study set at a=5% (one side test, right) with referring to Chi-Square statistical tables, the value of χ^2 tab=3.841. When comparing χ^2 tab with the actual value in table 3 χ^2 cal=35.063, we found that

χ^2 tab<χ^2 cal with p=0.000<0.05. This result was the acceptance of H_1 and the rejection of H_0.

The decision we reached with the aforementioned result, table 1, and chart 2 was: There was significant difference in the percentages p=0.000<0.05. The percentage of patients with first permanent molar loss was up to 31.3% and less than the percentage of patients without first permanent molar loss that was up to 68.7%.

Table 3: Loss by patient type Chi-Square Test/Test Statistics

	Loss by Patient type
Chi-Square	35.063[a]
df	1
Asymp. Sig.	.000

II. First upper and lower permanent molar loss

We tested the null hypothesis H_0 which stated that the percentages of first upper molar loss and first lower molar loss were equal at a confidence level 95%.

Table 4 shows that the Mean of observed first upper molar loss was 0.13 and first lower molar loss was 0.34. In addition, the standard deviation was 0.409, 0.607 for the aforementioned two types of molar loss, respectively. Furthermore, Mode=0 which indicated that the existing first permanent molars were more prevalent than the missing first permanent molars for the two types of first upper and lower permanent molars according to this study encoding 0 = No missing molars, 1=one missing molar,
2=two missing molars.

Table 4: Loss by Tooth Type Descriptive Statistics

	N	Sum	Mean	Std. Deviation	Mode
1st upper permanent molar loss	252	32	.13	.409	0
1st lower permanent molar loss	252	85	.34	.607	0
Valid N (listwise)	252				

Table 5 shows that the frequency of first lower permanent molar loss was 85 observations (72.6%), and it was more than the frequency of first upper permanent molar loss which was 32 observations (27.4%).

Table5: Loss by Tooth Type Frequency and percentages

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st upper permanent molar loss	32	27.4	27.4	27.4
	1st lower permanent molar loss	85	72.6	72.6	100.0
	Total	117	100.0	100.0	

The question of this study: Were first upper molar loss and first lower molar loss observations distributed in equal proportions? In another word: Was the difference in the percentages of first upper molar loss and first lower molar loss significant or insignificant? at a confidence level 95%.

To answer this question, we tested the null hypothesis H_0 versus the alternative hypothesis H_1 which stated that there was significant difference in the percentages (number of observations) of first upper molar loss and first lower molar loss.

H_0: $p_{1^{st} \text{ upper permanent molar loss}} = p_{1^{st} \text{ lower permanent molar loss}} = \frac{1}{2}$

H_1: $p_{1^{st} \text{ upper permanent molar loss}} \neq p_{1^{st} \text{ lower permanent molar loss}} \neq 0$

Table 6: Loss by Tooth Type Chi-Square Test / Frequencies

|	Observed N	Expected N	Residual
1st upper permanent molar loss	32	58.5	-26.5
1st lower permanent molar loss	85	58.5	26.5
Total	117		

Table 6 shows the observed and the expected number of first upper and lower molar loss. According to $\chi 2$ Chi-Square Test, the expected number was equal for each of the two types of first permanent molar loss (58.5), and this what the null hypothesis stated. So, was the hypothesis accepted or not? By following the same process in results I, the answer of this question came in table 7 which contains the results of the study test.

When comparing $\chi 2$ tab=3.841 with the actual value in table 7 $\chi 2$ cal=24.009, we found that $\chi 2$ tab $<\chi 2$ cal with p=0.000<0.05. This result was the acceptance of H_1 and the rejection of H_0.

The decision we reached with the aforementioned result, table 5, chart 1, and chart 3 was: There was significant difference in the percentages (number of observations) p=0.000<0.05. The percentage of first lower permanent molar loss was up to 72.6% and more than the percentage of first upper permanent molar loss that was up to 27.4 %.

Table7: Loss by Tooth Type Chi-Square Test/Test Statistics

	Loss by Tooth type
Chi-Square	24.009[a]
df	1
Asymp. Sig.	.000

Chart 1: First Upper and Lower Permanent Molar Loss
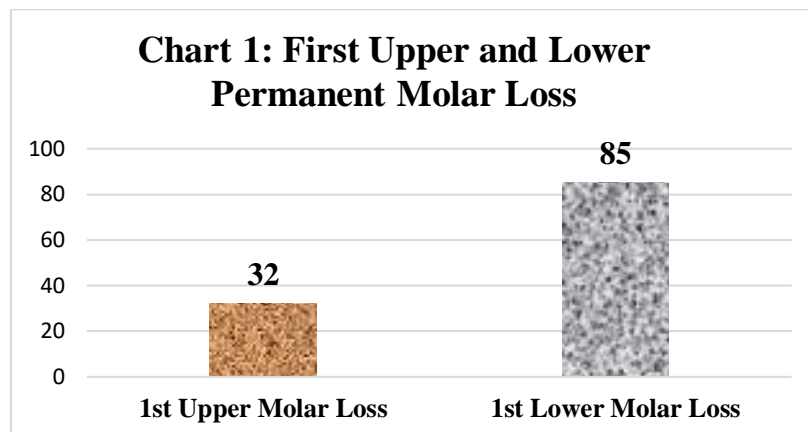
III.   Reasons for first permanent molar loss

The number of first upper and lower permanent molar loss observations because of caries was 79 observations, and there were no loss observations because of periodontal disease or other reasons. This meant that caries was the dominant reason for molars loss with a percentage of 100%. There was exact matching between observed and expected number (no residuals).

Discussion

Reasons for tooth mortality (loss)

In this study, the main reason for tooth loss was consistent with literature which was caries. For instance, a study conducted in Kuwait (participants aged 12-83 years) considered caries (43.7%) to be the most frequent reason for tooth loss followed directly by periodontal disease (37.4%), and molars were commonly extracted due to caries. Caries was the principal cause of extraction in patients ≤ 40 years of age (60.7%) while periodontal disease was the main cause of extraction in patients≥ 40 years of age (63.0%).[3] Another study done in Jordan (subjects aged 20-60 years)found that caries and its consequences (56.4%) were responsible for tooth loss in patients under 40 years of age while extraction because of periodontal problems (23.4%) increased with age.[4] In addition, a study done in South Wales showed that caries was the main reason for tooth extraction (59%) for patients attending for routine dental treatment, and periodontal disease was the

second most common reason (29%) for tooth extraction.[5] Furthermore, it was found in Brazil that (70.3%) of tooth extraction was because of caries which was of the first rank while (15.1%) was because of periodontal disease which was of the second rank.[6] Moreover, a study done in Nigeria (patients 14-89 years of age)suggested that the first two reasons for tooth loss were caries and its sequelae (86.2%) and periodontal disease (6.6%), respectively.[7]Also, a study in Greece noticed that tooth loss increased steadily with age and was higher for the periodontitis group than the gingivitis.[8] Another study done in Brazil (subjects aged 15-25 years) found that caries was the main reason for tooth loss while there was no incidence of tooth loss due to periodontal disease. The result of this Brazilian study was consistent with other reports suggesting that dental caries not periodontal destruction was the most significant cause of tooth loss in younger populations.[9] Furthermore, a study done by Alesia et al. in a Saudi population found that dental caries was the main and most common reason for tooth extraction as accounted for the majority (50.2%) of extractions in all age groups.[10]

Finally, a study done by Sayegh et al. in Jordan found that (46.9%) of teeth were lost due to caries and its sequel, and (18%) were lost because of periodontal disease. It also found that caries and its sequel was the predominant cause of tooth loss in patients ≤ 40 years of age whereas periodontal

extractions were predominant for the above 40-year-old group. In addition, the most frequently extracted teeth due to caries were lower first and second molars while lower incisors were most commonly extracted for periodontal disease.[11]

The results of Sayegh et al. study as well as this study were consistent with the results of two Canadian studies. The first found that posterior teeth were most frequently lost by the younger age groups and anterior teeth by older subjects.[12]The second found that caries was an important cause of tooth loss at all ages, and periodontal disease accounted for more teeth lost after 40 years of age than caries.[13]

The first lower permanent molar is the most frequently missing tooth:

In this study, the most frequently missing tooth type was consistent with literature which was the first lower permanent molar. For instance, a study conducted in Kuwait found that the most commonly extracted teeth were the mandibular first permanent molars (17.9%).[3] Also, a study done in Nigeria found that the most frequently extracted teeth were the first lower permanent molars.[7] In addition, a study conducted in Brazil (subjects aged 15-25 years)found that the most frequently missing teeth were again the mandibular first permanent molars (42%).[9] Another study done in Brazil (subjects aged 14-82 years) found that the mandibular first permanent molars were also the most commonly missing teeth.[14] Furthermore, a study done in Kuwait to determine the loss of first permanent molars in 13-14-year-old school children found that the

prevalence of tooth loss was 11.4% almost 70% occurred only in the mandible, and there were no gender differences.[15]

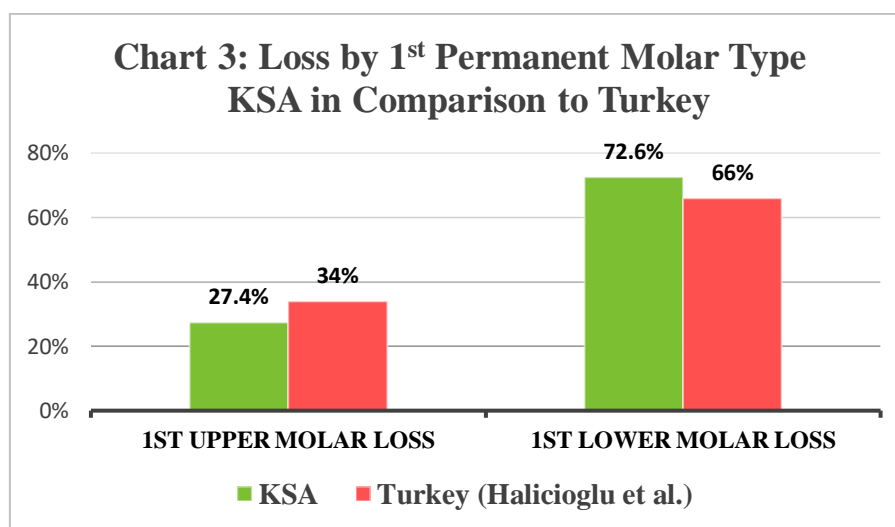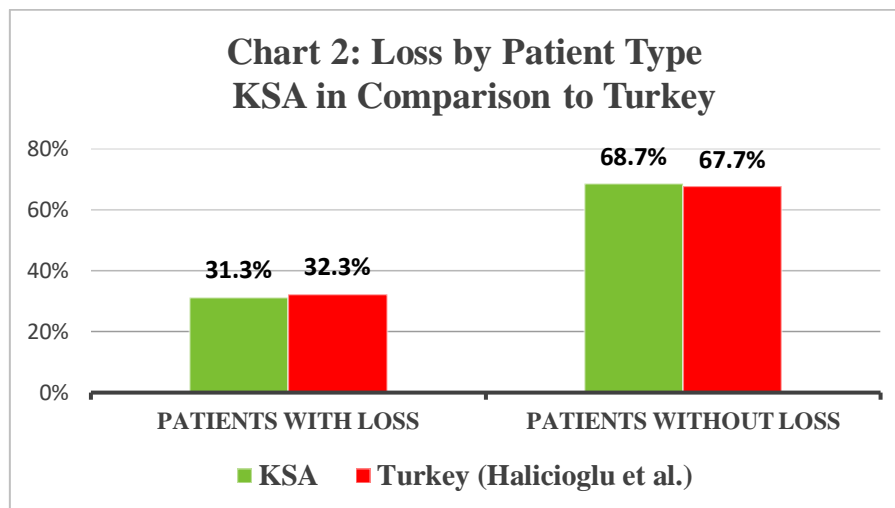### Caries and first permanent molar among young Saudis in Saudi Arabia

In 2006-2007, Atieh (Saudi participants aged 14-19 years) found that the prevalence of tooth loss was (40.9%) (n=198 subjects with tooth loss out of n=484 subjects). First permanent molars were the most frequently missing teeth (57.1%), and caries was the most common cause of tooth loss (81.8%).[16]

Comparison in details with Halicioglu et al.-Clin Oral Invest, Turkey

For the purpose of comparison with literature in details, we chose Halicioglu et al. The Journal of Clinical Oral Investigations 2014 because it was the study that tackled the same tooth type (first upper and lower permanent molar), the same age group (13-20) years, and there were no gender differences.[17] Halicioglu et al. study was conducted in Turkey between December 2010 and November 2012. The prevalence of the first permanent molar extraction in the Turkish study was detected to be (32.3%). A total of 945 patients (32.3%) presented with at least one first permanent molar extraction with no gender difference (p= 0.297). The total number of extracted first permanent molars was (1615 teeth), and there were more cases of extracted mandibular first permanent molars (1066 teeth) than extracted maxillary first permanent molars (549 teeth) (p < 0.001).[17]

Table 8: Comparison of loss by first permanent molar type and by patient type between KSA and Turkey according to percentages prevalence.[17]

Country	Loss by Patient Type	
	Patients With Loss %	Patients Without Loss %
KSA	31.3%	68.7%
Turkey	32.3%	67.7%
	Loss by Tooth Type	
	1st Upper Permanent Molar Loss %	1st Lower Permanent Molar Loss %
KSA	27.4%	72.6%
Turkey	34%	66%

**Chart 2: Loss by Patient Type
KSA in Comparison to Turkey**

**Chart 3: Loss by 1st Permanent Molar Type
KSA in Comparison to Turkey**

The comparison results were (table 8/charts 2 and 3):

The prevalence of first permanent molar loss (patients with loss) was 31.3% in this study (KSA). However, it was slightly higher 32.3% in Halicioglu et al. study (Turkey) with 1% difference between the two populations.

In this study (KSA) and in Halicioglu et al. study (Turkey), the most frequently missing tooth type was the first lower permanent molar. First lower permanent molar loss was 72.6% in this study (KSA). However, it was 66% in Halicioglu et al. study (Turkey).

First upper permanent molar loss was 27.4% in this study (KSA). However, it was 34% in Halicioglu et al. study (Turkey).

Conclusion

The results of this study indicate that first lower permanent molars are the most frequently extracted/lost due to caries. Further early childhood preventive and dental education programs need to be implemented and assessed focusing on general dental health and targeting caries along with first permanent molars in particular including oral hygiene instructions, dental sealant, fluoride application, and periodical visits to dentist office.

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Conflicts of interest: None declared

References

1. Tooth eruption: The permanent teeth. The Journal of the American Dental Association. 2006;137:127.

2. Andrews LF. The six keys to normal occlusion. American Journal of Orthodontics and Dentofacial Orthopedics. 1972;62(3):296-309.

3. Al-Shammery KF, Al-Ansari JM, Al-Melh MA, Al-Khabbaz AK. Reasons for tooth extraction in Kuwait. Medical Principles and Practice. 2006;15(6):417-422.

4. QuteishTanni DS. Periodontal reasons for tooth extraction in adult population in Jordan. Journal of Oral Rehabilitation. 2003;30(1):110-112.

5. Richards W, Ameen J, Coll AM, Higgs G. Reasons for tooth extraction in four general dental practices in South Wales. British Dental Journal. 2005;198(5):275-278.

6. Caldas AF, Marcenes W, Sheiham A. Reasons for tooth extraction in a Brazilian population. International Dental Journal. 2000;50(5):267-273.

7. Saheeb BD, Sede MA. Reasons and pattern of tooth mortality in a Nigerian Urban teaching hospital. Annals of African Medicine. 2013;12(2):110-114.

8. Anagnou-Varelzides A, Komboli M, Tsami A, Mitsis F. Pattern of tooth loss in a selected population in Greece. Community Dentistry and Oral Epidemiology. 1986;14(6):349-352.

9. Cortelli JR, Pallos D, Krug T, Cortelli SC, Hart TC. Prevalence of missing teeth in adolescents and young adults. Brazilian Dental Science. 2001;4(2):20-27.

10. Alesia K, Khalil HS. Reasons for and patterns relating to the extraction of permanent teeth in a subset of the Saudi population. Clinical, Cosmetic and Investigational Dentistry. 2013;5:51-56.

11. Sayegh A, Hilow H, Bedi R. Pattern of tooth loss in recipients of free dental treatment at the University Hospital of Amman, Jordan. Journal of Oral Rehabilitation. 2004;31(2):124-130.

12. Murray H, Clarke M, Locker D, Kay EJ. Reasons for tooth extractions in dental practices in Ontario, Canada according to tooth type. International Dental Journal. 1997;47(1):3-8.

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

14. Corraini P, Baelum V, Pannuti CM, Pustiglioni AN, Romito GA, Pustiglioni FE. Tooth loss prevalence and risk indicators in an isolated population of Brazil. Acta Odontologica Scandinavica. 2009;67(5):297-303.

15. Artun J, Thalib L. Mesial migration and loss of first molars among young adolescents in Kuwait. Community Dental Health. 2011;28(2):154-159.

16. Atieh MA. Tooth loss among Saudi adolescents: social and behavioural risk factors. International Dental Journal. 2008;58(2):103-108.

17. Halicioglu K, Toptas O, Akkas I, Celikoglu M. Permanent first molar extraction in adolescents and young adults and its effect on the development of third molar. Clinical Oral Investigations. 2014;18(5):1489-1494.

18. Răducanu AM, Feraru V, Herteliu C, Răducanu MA. Prevalence of loss of permanent first molars in a group of Romanian children and adolescents. Oral Health and Dental Management in the Black Sea Countries. 2009;VIII(3):3-10.