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DOI: <https://dx.doi.org/10.18535/ijetst/v6i2.01>**Original Research Article****Prevalence of and Reasons for Tooth Loss in a Saudi Population**

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Riyadh Elm University, Riyadh, Kingdom of Saudi ArabiaEmail: [dent.sci.research@gmail.com](mailto:dent.sci.research@gmail.com)**Abstract**

**Aim:** The aim of this study was to detect the prevalence of and reasons for permanent tooth extractions in a Saudi population in Saudi Arabia.

**Materials and Methods:** 404 Saudi patients aged  $\geq 10$  years residing in the Kingdom of Saudi Arabia were randomly selected and clinically examined for extracted or diagnosed for extraction maxillary and mandibular permanent teeth. The study was carried out from November 2018 to February 2019. The reason for extraction was documented whether by asking the patient why his/her tooth was extracted or by clinical and radiographic examination for the tooth diagnosed for extraction. The criteria for extraction categories (reasons) were adapted based on Murray et al. 1996,<sup>3</sup> and one reason for each tooth was recorded. The data obtained were documented in a patient examination form then statistically analyzed.

**Results:** A total of 1473 teeth were extracted or diagnosed for extraction from 404 patients. The prevalence of patients who lost at least one tooth was (73.3%). The majority of patients lost 4-8 teeth (38.4%). In addition, the prevalence of patients who didn't lose any teeth was the highest in the age group 10-29 years; however, the prevalence of patients who lost  $> 8$  teeth was the highest in the age group  $\geq 51$  years. The highest percentage of extracted teeth was in the lower posterior region (48.5%), and the lowest percentage of extracted teeth was in the lower anterior region. Furthermore, there was an insignificant difference in the mean number of extracted teeth between males and females  $p > 0.05$ . Moreover, caries was the most common reason for tooth extractions in all ages (60.6%), followed by eruption problems (20.8%), periodontal disease (7.9%), orthodontics (6.4%), prosthodontics (1.8%), pericoronitis (1.6%), and trauma (0.9%). The mean number of extracted teeth per patient by caries was  $(4.24 \pm 3.516)$ . The mean number of extracted teeth per patient was higher in the oldest age group  $\geq 51$  years than in the youngest age group 10-29 years. The percentages of extracted teeth due to caries and eruption problems were higher in patients  $\leq 40$  years than in patients  $> 40$  years, and they due to orthodontics and pericoronitis were the highest in patients 10-29 years; however, they due to periodontal disease were higher in patients  $> 40$  years than in patients  $\leq 40$  years.

**Conclusion:** Caries is epidemic; it's advised to intensify efforts towards dental sealants and fluoride application with implementing dental preventive and educational programs in order to raise the public awareness of oral hygiene instructions and natural dentition.

**Keywords:** Prevalence, Reasons, Regions, Gender, Age, Extracted, Tooth/Teeth, Patient.

## Introduction

Tooth loss continues to be a major public health concern worldwide because of the importance of dental health on the general physical and psychological status of individuals. Permanent tooth loss happens because of various reasons including dental caries, periodontal disease, orthodontic treatments, traumatic injuries, eruption problems, prosthetic indications, pericoronitis, and patient's request.<sup>1-23</sup> The reasons for tooth loss in Scotland were unknown until 1986 when Kay and Blinkhorn published the findings of a study which they had carried out in 1984.<sup>21</sup> Since that time, many studies such as Murray et al. 1996, Richards et al. 2005, and McCaul et al. 2001 have replicated many aspects including the criteria for extraction categories of Kay and Blinkhorn study with or without modifications.<sup>3,5,21,24</sup> In the same context, many studies such as Montandon et al., Alaboudi et al., and Manekar et al. adapted the reasons for tooth extraction based on Cahen et al. who applied the same methods of Ainamo et al. study which had conducted a survey in Finland 1984 on the causes of tooth extraction.<sup>10,15,20,22,25</sup> With the revolutionary changes facing human societies in the 21<sup>st</sup> century in lifestyle, dietary habits, education, and the rise of recent oral health educational and preventive programs in many countries, such as Saudi Arabia, it's important to keep searching for the incidence of and reasons for tooth loss in order to help official authorities direct health policies towards the main problems, implement factual and effective dental public health preventive policies, and avoid random ineffective schemes. In addition, because there are discrepancies between countries, more research is needed to be carried out in order to find out the common global phenomena. For instance, almost all studies worldwide considered dental caries and periodontal disease two major reasons for tooth loss in their countries<sup>1-13,15,16,18,20-23</sup> despite the fact that some studies found that dental caries was the main reason for tooth loss in their countries,<sup>1,2,4,5,7-13,15,16,19-22</sup> while other studies found that periodontal disease was the main reason for tooth loss in their countries.<sup>3,18,23</sup>

## Materials and Methods

### Ethical approval

The study was registered with the research center of Riyadh Elm University (FRP/2018/252) and received ethical approval from the institutional review board of the same institution (RC/IRB/2018/1278).

### Selection of the content for analysis and statistical analysis

404 Saudi patients aged  $\geq 10$  years residing in Saudi Arabia were randomly selected. The study was conducted from November 2018 to February 2019. After taking the patient consent on an informed consent statement form for clinical studies, each patient was clinically examined for extracted or diagnosed for extraction maxillary and mandibular permanent teeth. Also, radiographic examination was used including panoramic, periapical, and bitewing radiographs. Using the criteria for extraction categories based on Murray et al. 1996,<sup>3</sup> the reason for extraction was documented whether by asking the patient why his/her permanent tooth was extracted or by clinical and radiographic examination for the permanent tooth diagnosed for extraction, and one reason for each tooth was recorded. The criteria for extraction categories (reasons for tooth extractions) based on Murray et al. 1996<sup>3</sup> with some modifications were as the following:

**Caries:** As well as initial and recurrent caries, this category includes all sequelae of caries, including extracted roots, where the crown was lost through caries and teeth fracturing due to weakening by caries. Failed root treatments, initially treated because of caries, should also be placed in this category.

**Periodontal disease:** Where pain, loss of function or pocketing requires that the tooth be extracted.

**Orthodontic:** Teeth extracted to prevent or correct malocclusion, be they impacted, incompletely erupted or supernumerary.

**Prosthodontic:** Teeth which are extracted because their removal facilitates a better prosthetic restoration.

**Trauma:** This category should include teeth lost only as a result of trauma, including jaw fractures

(fractured restorations should be placed in the caries category).

**Pericoronitis:** Persistent inflammation around third molars which necessitates removal of one or all third molars.

**Eruption problems** (referred to as impacted in the original reference of Murray et al.<sup>3</sup>): Removal of unerupted or partially erupted tooth.

The data obtained were documented in a patient examination form then statistically analyzed using Chi-Square Test to test the association between categorical variables (age, reason, gender, regions of tooth extractions), Welch's ANOVA Test to test the differences in the mean number of extracted teeth per patient by reason for tooth extraction and to test the differences in the mean number of extracted teeth per patient by age, Independent Samples T-Test to test the differences in the mean number of extracted teeth per patient by gender, and Binary Logistic Regression for the nominal dependent variable (prevalence of tooth loss) and risk factors (age, gender) to calculate the Odd Ratio in order to compare the Odd Ratio of patients falling in tooth extraction versus patients not falling in tooth

extraction for each of the aforementioned risk factors. All statistical analyses were performed using the IBM SPSS Statistics 20 data processing software. The significance level was set at  $p < 0.05$ .

## Results

A total of 1473 permanent teeth were extracted or diagnosed for extraction from 404 patients.

### Prevalence of Tooth Loss

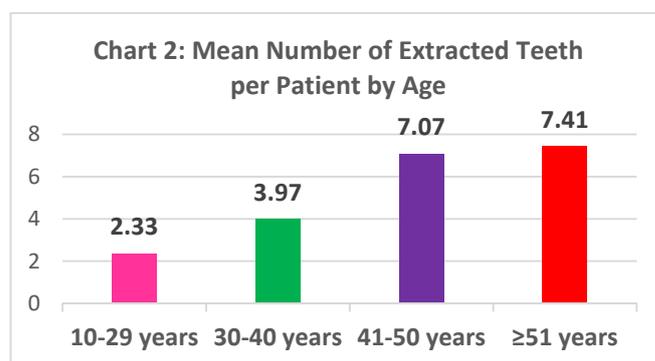
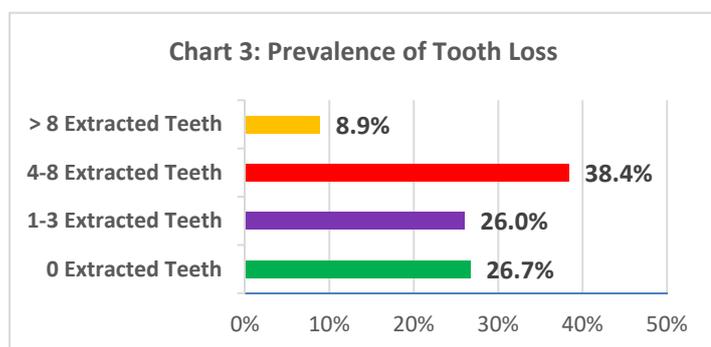
Chi-Square Test showed that there was a significant difference in the percentages (number of observations) of the prevalence of tooth loss  $p=0.000 < 0.05$  ( $df=1$ ,  $\alpha=5\%$  (one side test, right), with referring to Chi-Square statistical tables,  $\chi^2_{tab} = 3.841 < \chi^2_{cal} = 87.485$ ). Therefore, the prevalence of patients who lost at least one tooth was (73.3%), and the prevalence of patients who didn't lose any teeth was (26.7%). The sample size was ( $n=404$  patients) (males  $n=214$ , females  $n=190$ ). The total number of extracted teeth or diagnosed for extraction was ( $n=1473$  teeth). The mean number of extracted teeth per patient was ( $mean=3.65 \pm 4.161$ ) (Table1, Table2).

**Table 1:** Prevalence of Tooth Loss

Patients	Count (n)	Percent (%)
No Loss	108	26.7
At Least One Tooth Loss	296	73.3
Total	404	100.0

**Table 2:** Descriptive Statistics for Prevalence of Tooth Loss

	Count (n) Patients	Sum Total number of extracted teeth	Mean	Std. Deviation
Number of extracted teeth per patient	404	1473	3.65	4.161



### Mean Number of Extracted Teeth per Patient by Reason for Tooth Extraction

Welch's ANOVA Test showed that there were statistically significant differences in the mean number of extracted teeth per patient by reason for tooth extraction  $F(6, 62.454) = 26.400$   $p = 0.000 < 0.05$

(Table 3). Therefore, the mean number of extracted teeth per patient by reason was as the following:

Caries ( $4.24 \pm 3.516$ ), periodontal disease ( $3.48 \pm 3.563$ ), orthodontics ( $3.10 \pm 1.605$ ), eruption problems ( $2.56 \pm 1.246$ ), prosthodontics ( $1.85 \pm 1.460$ ), pericoronitis ( $1.77 \pm 1.092$ ), and

trauma (1.18±0.405) (Table 4, Chart 1). To test the significance of differences for each pair of reasons for tooth extraction, the multiple comparisons were used (Post Hoc Tests/Games-Howell) which showed that there were significant differences in the mean number of extracted teeth per patient between caries and prosthodontics  $p=0.000<0.05$ , caries and trauma  $p=0.000<0.05$ , caries and eruption problems  $p=0.000<0.05$ , caries and pericoronitis  $p=0.000<0.05$ . However, there were insignificant differences in the mean number of extracted teeth per patient between caries and periodontal disease  $p=0.915>0.05$ , caries and orthodontics  $p=0.055>0.05$  (Table 5).

**Mean Number of Extracted Teeth per Patient by Age**

Welch’s ANOVA Test showed that there were statistically significant differences in the mean number of extracted teeth per patient by age  $F(3,$

$85.521)=20.506 p=0.000<0.05$  (Table 6). Therefore, the mean number of extracted teeth per patient by age was as the following:

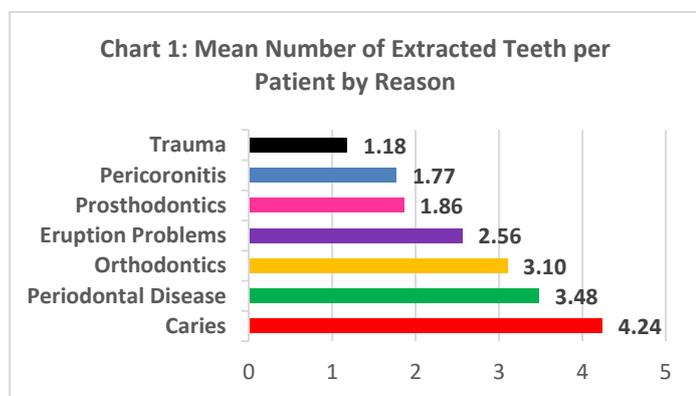
10-29:  $2.33±2.950$ ; 30-40:  $3.97±2.923$ ; 41-50:  $7.07±5.227$ ;  $≥51: 7.41±7.193$  (Table 7, Chart 2). To test the significance of differences for each pair of age groups, the multiple comparisons were used (Post Hoc Tests/Games-Howell) which showed that there were significant differences in the mean number of extracted teeth per patient between all the pairs of age groups except for the pair 41-50 years and  $≥51$  years  $p=0.996>0.05$ , the pair 30-40 years and  $≥51$  years  $p=0.058 >0.05$  (Table 8).

**Table 3:** Robust Tests of Equality of Means Number of extracted teeth per patient

	Statistic	df1	df2	Sig.
Welch	26.400	6	62.454	.000

**Table 4:** Descriptive Number of Extracted Teeth per Patient by Reason

Reason for Tooth Extraction	N	Mean	Std. Deviation
Caries	210	4.24	3.516
Periodontal disease	33	3.48	3.563
Orthodontics	30	3.10	1.605
Prosthodontics	14	1.86	1.460
Trauma	11	1.18	.405
Eruption problems	119	2.56	1.246
Pericoronitis	13	1.77	1.092
Total	430	3.41	2.916



**Table 5:** Multiple Comparisons (Post Hoc Tests)

Reason per patient I	Reason per patient J	Mean Difference I-J	Sig.
Caries	Periodontal Disease	0.753	0.915
	Orthodontics	1.138	0.055
	Prosthodontics	2.381	0.000
	Trauma	3.056	0.000
	Eruption Problems	1.675	0.000
	Pericoronitis	2.469	0.000
Periodontal Disease	Orthodontics	0.385	0.998
	Prosthodontics	1.628	0.305
	Trauma	2.303	0.014
	Eruption Problems	0.922	0.765
	Pericoronitis	1.716	0.190
Orthodontics	Prosthodontics	1.243	0.182
	Trauma	1.918	0.000
	Eruption Problems	0.537	0.615
	Pericoronitis	1.331	0.048
Prosthodontics	Trauma	0.675	0.654
	Eruption Problems	-0.706	0.605
	Pericoronitis	0.088	1
Trauma	Eruption Problems	-1.381	0.000
	Pericoronitis	-0.587	0.567
Eruption Problems	Pericoronitis	0.794	0.241

**Table 7:** Descriptive Number of Extracted Teeth per Patient by Age

Age Group, Years	N	Mean	Std. Deviation
10-29	230	2.33	2.950
30-40	98	3.97	2.923
41-50	44	7.07	5.227
≥51	32	7.41	7.193
Total	404	3.65	4.161

**Table 8:** Multiple Comparisons (Post Hoc Tests)

Age Group, YearsI	Age Group, YearsJ	Mean Difference I-J	Sig.
10-29	30-40	-1.639	0.000
	41-50	-4.738	0.000
	≥51	-5.76	0.002
30-40	41-50	-3.099	0.003
	≥51	-3.437	0.058
41-50	≥51	-0.338	0.996

**Mean Number of Extracted Teeth per Patient by Gender**

T-Test showed that there was an insignificant difference patient in the mean number of extracted teeth between males and females  $p=0.170>0.05$  (Table 9).

**Table 6:** Robust Tests of Equality of Means Number of extracted teeth per

	Statistic	df1	df2	Sig.
Welch	20.056	3	85.521	.000

**Table 9:** Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig.(2-tailed)
Number of extracted teeth per patient	2.823	.094	-1.373	402	0.170
Equal variances assumed			-1.358	369.094	0.175

**Regions of Tooth Loss and Age Groups**

Chi-Square Test showed that there was a statistically significant relationship between the regions of tooth loss and the age of the patient  $p=0.000<0.05$  ( $df=9$ ,  $\alpha=5\%$  (one side test, right), with referring to Chi-Square statistical tables,  $\chi^2_{tab}=16.919 < \chi^2_{cal}=121.171$ ). The Contingency Coefficient value was (28.2%) with  $p=0.000 < 0.05$ . Therefore, the highest percentage of extracted teeth was observed in the lower posterior region 48.5%, followed by the upper posterior region 44.2%, the upper anterior region 3.7%, and the lower anterior region 3.5%. In addition, of all age groups, the percentages of extracted teeth in the lower posterior region were higher in patients  $\leq 40$  years than in patients  $>40$  years and were the highest in the age group 10-29 years as the following: 10-29:40%; 30-40:27.6%; 41-50:18.6%;  $\geq 51$ :13.8%. Also, of all age groups, the percentages of extracted teeth in the upper posterior region were higher in patients  $\leq 40$  years than in patients  $>40$  years and were the highest in the age group 10-29 years as the following: 10-29:35.8%; 30-40:29.8%; 41-50:21%;  $\geq 51$ :13.4%. However, of all age groups, the percentages of extracted teeth in the lower

anterior region were higher in patients  $>40$  years than in patients  $\leq 40$  years and were the highest in the age group  $\geq 51$  years as the following:  $\geq 51$ :55.8%; 41-50:36.5%; 30-40:1.9%; 10-29:5.8%. Also, of all age groups, the percentages of extracted teeth in the upper anterior region were higher in patients  $>40$  years than in patients  $\leq 40$  years and were equally the highest in both age groups 41-50 years and  $\geq 51$  years as the following:  $\geq 51$ :36.4%; 41-50:36.4%; 30-40:7.3%; 10-29:20%.

**Age group 10-29 years:** Of all regions of tooth loss, the highest percentage of extracted teeth was in the lowest posterior region 53.7%, followed by the upper posterior region 43.7%, the upper anterior region 2.1%, and the lower anterior region 0.6%.

**Age group 30-40 years:** Of all regions of tooth loss, the highest percentage of extracted teeth was in the lower posterior region 49.7%, followed by the upper posterior region 49.0%, the upper anterior region 1.0%, and the lower anterior region 0.3%.

**Age group 41-50 years:** Of all regions of tooth loss, the highest percentage of extracted teeth was in the upper posterior region 44.3%, followed by the lower posterior region 43.0%, the upper anterior region 6.5%, and the lower anterior region 6.1%.

**Age group  $\geq 51$  years:** Of all regions of tooth loss, the highest percentage of extracted teeth was in the lower posterior region 42.1%, followed by the upper posterior region 37.0%, the lower anterior region 12.3%, and the upper anterior region 8.5%. The total number of extracted teeth in the study sample was  $n=1473$  (100%), and it was distributed on the age

groups as the following: 10-29 years  $n=533$  (36.2%), followed by 30-40 years  $n=396$  (26.9%), 41-50 years  $n=309$  (21%), and  $\geq 51$  years  $n=235$  (16%). Therefore, the highest percentage (number) of extracted teeth was observed in the age group 10-29 years, and the percentages (number) of extracted teeth decreased with age (Table 10).

**Table 10:** Regions of Tooth Loss and Age Groups

Age Group, Years	Region of Tooth Loss				Total
	Upper Anterior	Upper Posterior	Lower Anterior	Lower Posterior	
10-29 Count	11	233	3	286	533
30-40 Count	4	194	1	197	396
41-50 Count	20	137	19	133	309
$\geq 51$ Count	20	87	29	99	235
Total Count	55	651	52	715	1473

### Regions of Tooth Loss and Reasons for Tooth Extractions

Chi-Square Test showed that there was a statistically significant relationship between the regions of tooth loss and the reasons for tooth extractions  $p=0.000 < 0.05$  ( $df=18$ ,  $\alpha=5\%$  (one side test, right), with referring to Chi-Square statistical tables,  $\chi^2_{tab} = 28.869 < \chi^2_{cal} = 891.064$ ). The Contingency Coefficient value was (61.4%) with  $p=0.000 < 0.05$ . Therefore, of all reasons, the highest percentage of extracted teeth in the lower and the upper posterior regions was due to caries 62.8% and 64.8%, followed by eruption problems 22.8% and 21.7%, orthodontics 6.4% and 7.4%, periodontal disease 4.1% and 3.5%, prosthodontics 1.5% and 1.7%, pericoronitis 2.4% and 0.9%, and trauma 0% and 0%, respectively. However, of all reasons, the highest percentage of extracted teeth in the lower anterior region was due to periodontal disease 84.6%, followed by caries and prosthodontics (7.7%) and (7.7%), while all other reasons were 0%. Furthermore, of all reasons, the highest percentage of extracted teeth in the upper anterior region was due to periodontal disease 38.2%, followed by caries 32.7%, trauma 23.6%, eruption problems 3.6%, prosthodontics 1.8%, and pericoronitis 0%. On the other hand, of all regions, the highest percentage of extracted teeth due to caries was in the lower posterior region 50.3%, followed by the upper posterior region 47.3%, the upper anterior region

2.0%, and the lower anterior region 0.4%; however, of all regions, the highest percentage of extracted teeth due to periodontal disease was in the lower anterior region 37.6%, followed by the lower posterior region 24.8%, the upper posterior region 19.7%, and the upper anterior region 17.9%. Also, of all regions, the highest percentage of extracted teeth due to orthodontics was in the upper posterior region 51.5%, followed by the lower posterior region 48.9%; the upper and the lower anterior regions didn't have any extracted teeth due to orthodontics. In addition, of all regions, the highest percentage of extracted teeth due to prosthodontics was equally observed in the upper and the lower posterior regions 40.7% and 40.7%, followed by the lower anterior region 14.8%, and the upper anterior region 3.7%. Of all regions, extracted teeth due to trauma were totally found in the upper anterior region 100%. Finally, of all regions, the percentages of extracted teeth due to eruption problems and pericoronitis were the highest in the lower posterior region 53.5% and 73.9%, followed by the upper posterior region 46.1% and 26.1%, respectively; only eruption problems occurred in the upper anterior region 0.7% (Table 11).

**Table 11:** Regions of Tooth Loss and Reasons for Tooth Extractions

Reasons for Tooth Extractions		Regions for Tooth Extractions				Total
		Upper anterior	Upper posterior	Lower anterior	Lower posterior	
Caries	Count	18	422	4	449	893
Periodontal disease	Count	21	23	44	29	117
Orthodontics	Count	0	48	0	46	94
Prosthodontics	Count	1	11	4	11	27
Trauma	Count	13	0	0	0	13
Eruption problems	Count	2	141	0	163	306
Pericoronitis	Count	0	6	0	17	23
Total	Count	55	651	52	715	1473

### Regions of Tooth Loss and Gender

Chi-Square Test showed that there was an insignificant relationship between the regions of tooth loss/extractions and the gender of the patient  $p=0.781>0.05$ .

### Prevalence of Tooth Loss and Age Groups

Chi-Square Test showed that there was a statistically significant relationship between the prevalence of tooth loss and the age of the patient  $p=0.000<0.05$  ( $df=9$ ,  $\alpha=5\%$  (one side test, right), with referring to Chi-Square statistical tables,  $\chi^2_{tab}=16.919 < \chi^2_{cal}=92.106$ ). The Contingency Coefficient value was (43.1%) with  $p=0.000 < 0.05$ . Therefore, of the (73.3%) patients who lost at least one tooth, (26%) patients lost 1-3 teeth, (38.4%) patients lost 4-8 teeth, and (8.9%) patients lost  $>8$  teeth (Table 12, Chart 3). In addition, of all age groups, the percentages of patients who lost  $>8$  teeth were higher in age groups  $>40$  years than in age groups  $\leq 40$  years and were the highest in the age group  $\geq 51$  years as the following:  $\geq 51:30.6\%$ ;  $41-50:27.8\%$ ;  $30-40:25\%$ ;  $10-29:16.7\%$ . However, of all age groups, the percentages of patients who lost 1-3 teeth were higher in age groups  $\leq 40$  years than in age groups  $>40$  years and were the highest in the age group 10-29 years as the following:  $10-29:57.1\%$ ;  $30-40:28.6\%$ ;  $41-50:7.6\%$ ;  $\geq 51:6.7\%$ . Also, of all age groups, the percentages of patients who lost 4-8 teeth were higher in age groups  $\leq 40$  years than in age groups  $>40$  years and were the highest in the age group 10-29 years as the following:  $10-29:46.5\%$ ;  $30-40:29.7\%$ ;  $41-50:16.8\%$ ;  $\geq 51:7.1\%$ . Moreover, of all age groups, the percentages of patients who didn't lose any teeth were higher in age groups  $\leq 40$

years than in age groups  $>40$  years and were the highest in the age group 10-29 years as the following:  $10-29:85.2\%$ ;  $30-40:12\%$ ;  $41-50:0\%$ ;  $\geq 51:2.8\%$ . **Age group 10-29 years:** Of all teeth groups, the percentage of patients who lost teeth was higher 60% than patients who didn't lose any teeth 40%. In addition, of all the 60% patients who lost teeth, the highest percentage of patients who lost teeth was observed in the 4-8 extracted teeth group 31.3%, followed by the 1-3 extracted teeth group 26.1%, and the  $>8$  extracted teeth 2.6% group. **Age group 30-40 years:** Of all teeth groups, the percentage of patients who lost teeth was higher 86.7% than patients who didn't lose any teeth 13.3%. In addition, of all the 86.7% patients who lost teeth, the highest percentage of patients who lost teeth was observed in the 4-8 extracted teeth group 46.9%, followed by the 1-3 extracted teeth group 30.6%, and the  $>8$  extracted teeth group 9.2%. **Age group 41-50 years:** Of all teeth groups, the percentage of patients who lost teeth was higher 100% than patients who didn't lose any teeth 0%. In addition, of all the 100% patients who lost teeth, the highest percentage of patients who lost teeth was observed in the 4-8 extracted teeth group 59.1%, followed by the  $>8$  extracted teeth group 22.7%, and the 1-3 extracted teeth group 18.2%. **Age group  $\geq 51$  years:** Of all teeth groups, the percentage of patients who lost teeth was higher 90.6% than patients who didn't lose any teeth 9.4%. In addition, of all the 90.6% patients who lost teeth, the highest percentage of patients who lost teeth was equally observed in both the 4-8 extracted teeth group 34.4% and the  $>8$  extracted teeth group 34.4%, followed by the 1-3 extracted teeth group 21.9% (Table 12).

**Table 12:** Prevalence of Tooth Loss and Age Groups

Age Group, Years		Teeth Group				Total
		0 extracted teeth	1-3 extracted teeth	4-8 extracted teeth	>8 extracted teeth	
10-29	Count	92	60	72	6	230
30-40	Count	13	30	46	9	98
41-50	Count	0	8	26	10	44
≥51	Count	3	7	11	11	32
Total	Count	108	105	155	36	404
	percent	26.7%	26.0%	38.4%	8.9%	100%

### Reasons for Tooth Extractions and Age Groups

Chi-Square Test showed that there was a statistically significant relationship between the reasons for tooth extractions and the age of the patient  $p=0.000 < 0.05$  ( $df=18$ ,  $\alpha=5\%$  (one side test, right), with referring to Chi-Square statistical tables,  $\chi^2_{tab}=28.869 < \chi^2_{cal}=401.532$ ). The Contingency Coefficient value was (46.3%) with  $p=0.000 < 0.05$ . Therefore, the reasons for tooth extractions were distributed as the following: caries (60.6%), followed by eruption problems (20.8%), periodontal disease (7.9%), orthodontics (6.4%), prosthodontics (1.8%), pericoronitis (1.6%), and trauma (0.9%) (Table 13, Chart 4). Also, of all reasons for tooth extractions, caries was the first and main reason for tooth extractions in all age groups 10-29:44.5%; 30-40:73%; 41-50:71.5%; and  $\geq 51$ :62.1%, and periodontal disease was the second most common reason for tooth extractions only in older age groups  $\geq 51$ :29.4% and 41-50:10%, while eruption problems were the second most common reason for tooth extractions only in younger age groups 10-29:35.6% and 30-40:19.7% (Chart 5). In addition, of all age groups, it was observed that the percentages of extracted teeth because of periodontal disease were higher in patients > 40 years of age than in patients  $\leq 40$  years of age 10-29:10.3%; 30-40:4.3%; 41-50:26.5%; and  $\geq 51$ :59%; however, of all age groups, the percentages of extracted teeth because of orthodontic reasons were higher in patients < 30 years of age than in patients  $\geq 30$  years of age 10-29:71.3%; 30-40:12.8%; 41-50:16%; and  $\geq 51$ :0%; in addition, of all age groups, the percentages of extracted teeth because of caries were higher in patients  $\leq 40$  years of age than in patients > 40 years of age 10-29:26.5%; 30-40:32.4%; 41-50:24.7%; and  $\geq 51$ :16.3%; also, of all age groups,

the percentages of extracted teeth because of eruption problems, such as impaction were higher in patients  $\leq 40$  years of age than in patients > 40 years of age and were the highest in the age group 10-29 years as the following: 10-29:62.1%; 30-40:25.5%; 41-50:8.2%; and  $\geq 51$ :4.2%; furthermore, of all age groups, the percentages of extracted teeth due to pericoronitis were the highest in the age group 10-29 years as the following: 10-29:65.2%; 30-40:13%; 41-50:17.4%; and  $\geq 51$ :4.3%. Moreover, of all age groups, the percentages of extracted teeth because of trauma were the highest in the age group 10-29 years, followed by the age group  $\geq 51$  as the following: 10-29:38.5%; 30-40:15.4%; 41-50:15.4%; and  $\geq 51$ :30.8% (Table 13).

### Reasons for Tooth Extractions and Gender

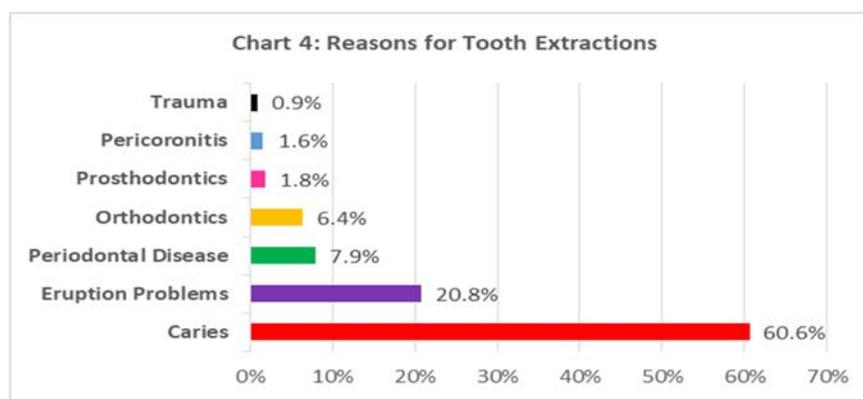
Chi-Square Test showed that there was a statistically significant relationship between the reasons for tooth extractions and the gender of the patient (male/female)  $p=0.000 < 0.05$  ( $df=6$ ,  $\alpha=5\%$  (one side test, right), with referring to Chi-Square statistical tables,  $\chi^2_{tab}=12.592 < \chi^2_{cal}=89.921$ ). The Contingency Coefficient value was 24.0% with  $p=0.000 < 0.05$ . Therefore, when comparing males with females, it was observed that the percentages of extracted teeth were more in females than in males due to caries (52.8%) females and (47.2%) males, orthodontics (91.5%) females and (8.5%) males, prosthodontics (77.8%) females and (22.2%) males, and pericoronitis (73.9%) females and (26.1%) males. However, the percentages of extracted teeth were more in males than in females due to periodontal disease (53.8%) males and (46.2%) females. On the other hand, when comparing the reasons for tooth extractions within the same gender category, it was observed that of all

reasons for tooth extractions, caries was the predominant reason in males (62.5%). Also, when comparing the reasons for tooth extractions in the same gender category, it was observed that of all

reasons for tooth extractions, caries was the predominant reason in females (58.8%).

**Table 13: Reasons for Tooth Extractions and Age Groups**

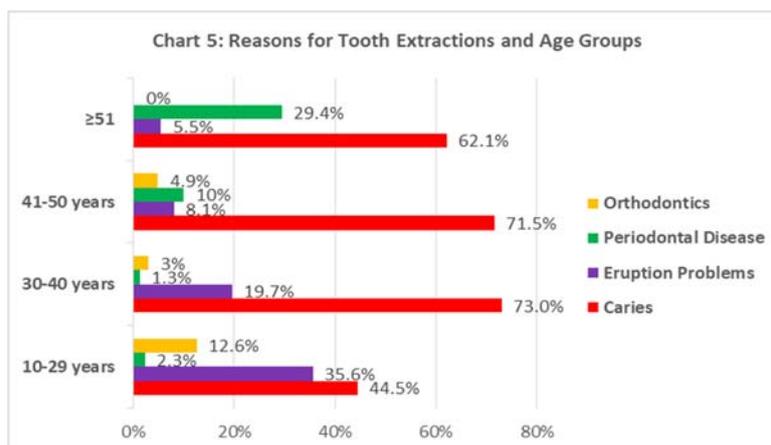
Age Group, Years	Reasons for Tooth Extractions							Total	
	Caries	Periodontal Disease	Orthodontics	Prosthodontics	Trauma	Eruption Problems	Pericoronitis		
10-29	Count	237	12	67	7	5	190	15	533
30-40	Count	289	5	12	7	2	78	3	396
41-50	Count	221	31	15	11	2	25	4	309
≥51	Count	146	69	0	2	4	13	1	235
Total	Count	893	117	94	27	13	306	23	1473
	percent	60.6%	7.9%	6.4%	1.8%	0.9%	20.8%	1.6%	100%



**Odd Ratio of the Prevalence of Tooth Loss and Age Groups**

Because Chi-Square Test showed that there was an insignificant relationship between the prevalence of tooth loss and the gender of the patient  $p=0.760>0.05$ , the gender was excluded from Binary Logistic Regression Test. Binary Logistic Regression Test showed that there was a statistically significant relationship between the prevalence of tooth loss and the age of the patient with significant  $\chi^2 = 62.898$   $p=0.000<0.05$  for the model.

Binary Logistic Regression showed that patients 10-29 years were 84.5% less likely -lower risk- to fall in tooth extraction as patients  $\geq 51$  years Odd Ratio = 0.155 (Lower Bound = 0.046, Upper Bound = 0.524) at a confidence level 95%. However, Binary Logistic Regression showed that the age 30-40 years and the age 41-50 years didn't differentiate the prevalence of tooth loss  $p=0.563> 0.05$  and  $p=0.998>0.05$ , respectively (Table 14).



**Table 14:** Binary Logistic Regression Odds Ratios

Age Group, Years	B	Sig.	Odd Ratio	95% C.I. for Odd Ratio	
				Lower	Upper
Age		.000			
10-29	-1.863	.003	.155	.046	.524
30-40	-.391	.563	-	-	-
41-50	18.934	.998	-	-	-

\*The reference group for the prevalence is no tooth loss

\*\*The reference group for the age is  $\geq 51$  years

## Discussion

The results of this study were consistent with literature which considered dental caries and periodontal disease major reasons for tooth loss.<sup>1-13,15,16,18,20-23</sup> In addition, of all reasons for tooth extractions, this study with almost all studies indicated to dental caries as the main and leading cause of tooth extractions.<sup>1,2,4,5,7-13,15,16,19-22</sup> Although Murray et al. found that periodontal disease was the leading cause of tooth extractions, the study considered caries as an important cause of tooth loss at all ages.<sup>3,18</sup> Furthermore, of all age groups, the present study was in accordance with literature and observed that tooth extractions because of caries were more in patients  $\leq 40$  years of age than in patients  $> 40$  years of age,<sup>1,2,4,6,8-12,20-22</sup> while tooth extractions because of periodontal disease were more in patients  $>40$  years of age than in patients  $\leq 40$  years of age.<sup>1-4,6-13,20-22</sup> Moreover, this study agreed with studies done in Kuwait, India, Saudi Arabia, Scotland, and France that tooth extractions because of orthodontics occurred more in young patients  $<30$  years than in patients  $>30$  years.<sup>9,12,16,20-22</sup> Also, Cahen et al., in line with the present study, found that removal of impacted teeth was the highest in young age groups  $\leq 30$  years.<sup>22</sup> In addition, in Scotland and Canada, McCaul et al. and Murray et al. agreed with the present study that tooth extractions due to pericoronitis occurred in young age groups 21-30 years in Scotland<sup>21</sup> and 13-19 years in Canada.<sup>3</sup> The present study found that teeth in the lower and the upper posterior regions were mainly extracted due to caries, and this fact was consistent with many studies which found that molars were mainly extracted due to caries<sup>1,2,4,7-13,15,16,19,20,22</sup>; also, this study showed that tooth

extractions due to orthodontics were the highest in the upper and the lower posterior regions which agrees with the findings of other studies that extractions because of orthodontic reasons mostly involved the premolars<sup>2,4,12,16,22</sup>; in addition, in Jordan, Sayegh et al. agreed with the present study that maxillary incisors (upper anterior region) were the most commonly extracted teeth due to trauma<sup>4</sup>; also, in Nigeria, Saheeb et al. mentioned that trauma mainly accounted for extraction of anterior teeth.<sup>11</sup> Furthermore, in accordance with the present study, in Sudan, Khalifa et al. referred to periodontal disease as the main reason for mandibular incisors loss<sup>13</sup>; in addition, in Brazil, Caldas et al. found that mandibular incisors were more often removed because of periodontal disease,<sup>1</sup> and Cahen et al. found that mandibular front teeth were mainly extracted due to periodontal disease.<sup>22</sup> According to literature, canines were extracted due to prosthodontic<sup>2,4,12</sup> and periodontal disease reasons.<sup>2,9,12</sup> Moreover, the present study agreed with two studies done in Kuwait and Greece that females lost more teeth due to caries, while males lost more teeth due to periodontal disease in Greece<sup>7</sup>; females lost more teeth due to caries and orthodontics, while males lost more teeth due to periodontal disease in Kuwait.<sup>9</sup> Both the present study and the study done in the South West of Nigeria found that the highest percentage of extracted teeth was observed in the lower posterior region (48.5%) and (42.3%), respectively<sup>23</sup>; however, the prevalence of tooth loss was lower 33.6% in the South West of Nigeria than in the present study.<sup>23</sup> In addition, in Nigeria, Saheeb et al. found that there was no significant association between the gender and the number of extracted teeth<sup>11</sup>; also, in Canada,

Murray et al. mentioned that the mean number of extracted teeth didn't differ by gender.<sup>3</sup> The results of this study were close to the results found in the United Arab Emirates where the prevalence of patients with missing teeth upon examination was 75.1%, the majority of patients had >3 missing teeth 31.4%, the highest number of missing teeth was in the molar area, and the highest percentage of extracted teeth was in the age group < 30 years.<sup>17</sup> In the same context, in Sudan, the prevalence of patients with at least one missing tooth was 78%, and the mean number of missing teeth per patient was (3.6 ± 4.9).<sup>13</sup> However, in Brazil, more subjects 90% had at least one extracted tooth, and more subjects 39% had >8 extracted teeth than in the present study<sup>14</sup>; also, the mean number of extracted teeth per patient was higher (9.5) in Brazil than in the present study, and the age-dependent prevalence of tooth loss was higher than in the present study too.<sup>14</sup> On the contrary, in the US, in two adult populations which were the Veterans Affairs Dental Longitudinal Study and the Baltimore Longitudinal Study of Aging, less subjects had at least one extracted tooth (VADLS) (48%) and (BLSA) (19%) than in the present study<sup>26</sup>; also, the mean number of extracted teeth per patient in the two aforementioned US populations was lower than in the present study VADLS(1.5±2.8) BLSA (0.6±1.8).<sup>26</sup> For the VADLS US population, Al-Shammari et al. in Kuwait, Chrysanthakopoulos in Greece, and Khalifa et al. in Sudan, the mean number of extracted teeth per patient was higher in age groups ≥ 51 years than in age groups 10-29 years which agrees with the results of the present study.<sup>7,9,13,26</sup> Furthermore, in Canada, the mean number of extracted teeth per patient was lower than in the present study (2.3±2.5),<sup>3</sup> and less subjects aged ≥ 50 years lost one or more teeth 23.2% with lower mean number of tooth loss per patient (0.48±1.31) than in the present study<sup>27</sup>; In the same context, the mean number of extracted teeth per patient was lower in Scotland 1984:2; 1999:1.5 than in the present study.<sup>21</sup> In addition, the mean number of extracted teeth per patient was lower in Kuwait (1.73± 0.07) and in Greece 2.42 than in the present study<sup>7,9</sup>; in Kuwait, the mean number of extracted

teeth per patient by caries 1.33, by periodontal disease 2.47, and by orthodontics 1.72 was lower than in the present study<sup>9</sup>; however, in Greece, the mean number of extracted teeth by periodontal disease 3.62 and by caries and its sequelae 4.78 was higher than in the present study.<sup>7</sup>

**The present study was consistent with Alesia et al. 2013 study done in Saudi Arabia (patients aged from 10 to >70 years) as the following<sup>16</sup>:**

- The highest percentage of extracted teeth was observed in young subjects aged 10-29 years (present study) and 10-30 years (Alesia et al.).
- The four most common reasons for tooth extractions were: caries, eruption problems, periodontal disease, and orthodontics; caries was the main and leading reason for tooth extractions.
- Tooth extractions because of caries were more in females compared with males.
- Of all regions, tooth extractions due to trauma totally occurred in the anterior region.
- Of all regions, eruption problems were the highest in the lower posterior region, followed by the upper posterior region and mainly included molars; the majority of third molars extractions occurred in young age groups 10-29 years (present study) and 21-30 years (Alesia et al.); eruption problems were minor in the anterior region.
- Of all regions, tooth extractions due to orthodontics were the highest in the upper posterior region followed by the lower posterior region and occurred in young age groups 10-29 years (present study) and 10-20 years (Alesia et al.).
- Of all regions, caries mainly occurred in the upper and lower posterior regions.
- Anterior teeth were extracted due to caries, periodontal disease, and prosthodontics.

### Conclusion

Of 404 patients, patients 10-29 years were 84.5% less likely to fall in tooth extraction as patients ≥ 51 years. In addition, the mean number of extracted teeth per patient was higher in patients ≥ 51 years than in patients 10-29 years. However, of 1473 extracted teeth, the highest percentage (number) of extracted teeth was observed in young patients 10-29 years. Moreover, the higher percentages of tooth extractions due to caries in females might reflect difficulties in commitment to periodic visits to

dentist office. Therefore, it's important to intensify efforts towards dental sealants and fluoride application. Tooth extraction should ideally be the last alternative choice among dental treatment options, and clinicians should be careful in deciding whether a tooth especially a healthy tooth should ever be removed.<sup>28</sup> Therefore, dentists must consider ethical principles and acceptable standards and protocols of diagnosis and treatment in the sense that the best interest of the patient has to be the driving force for the decision of extracting a tooth.<sup>28</sup> In this context, dentists hold responsibility for educating the public in general and women in particular about oral hygiene instructions and the importance of natural dentition through dental educational symposia and programs where women receive education on how to perceive beautiful smile for the purpose of ceasing tooth extractions due to prosthodontic and orthodontic reasons that might be unnecessary.

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