

The incidence rate of caries on individual tooth surfaces and its distribution by age and gender in clinic patients of Hawler Medical University/College of Dentistry: a retrospective cross-sectional study

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Background and objectives: Dental caries is one of the most prevalent chronic diseases, which is caused by cariogenic oral bacteria. This study is aimed to realize the distribution of caries on individual permanent tooth surfaces, and compares these results among various age groups and gender.

Methods: This cross-sectional study was conducted among clinic patients of Hawler Medical University/College of Dentistry in Erbil Governorate, Kurdistan, Iraq, over a span of four months in 2021. Thousand carious teeth were recorded in the Conservative Department. Individuals who reported, being over the age of 12 years old. Data were analyzed using Statistical Package for the Social Sciences (SPSS), version 25.

Results: Maxillary teeth (54.1%) were more susceptible to caries than mandibular teeth (45.9%). Caries incidence was the highest on the mandibular first molar (18.5%) and maxillary central incisor (18.4%). Class I caries was the most common type of carious lesion (32.2%). The incidence of caries was the highest among the individuals of age group II (20-39 Years). Females (54.6%) showed a higher caries incidence than males (45.4%).

Conclusion: The most prevalent tooth surface was the occlusal surface (Class I). The mandibular first molar was the most susceptible tooth to dental caries. Beside of that, females were found to be more prone to caries than males, and group II (20-39 years) had the highest rate of caries occurrence.

Key words: Dental caries, tooth surface, G.V. Black classification, age, gender.

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Introduction

Dental caries, otherwise known as tooth decay, is one of the most prevalent chronic diseases affecting human beings and persists to date as a challenge to the medical and dental profession in particular and society in general. Providing access to epidemiologic studies on dental caries is essential for staying up to date on the disease's latest developments, its treatment requirements, and the best strategies to prevent its development, limit its progression, and minimize its consequences.¹

Dental caries is the process of enamel or dentine demineralization caused by acid produced by cariogenic oral bacteria. This process is opposed by the natural function

of saliva to remineralize dental tissue by supplying calcium and phosphate ions that incorporate into the crystalline structure of tooth enamel. Caries progression is caused by an imbalance in the processes of demineralization and remineralization, eventually leading to cavitation. Many factors can affect the processes of demineralization and remineralization including bacterial flora, dietary, and oral hygiene behaviors, saliva composition and flow rate, PH buffering capacity, positional and morphological features of the teeth, fluoride exposures, and socioeconomic factors including access to oral health care.^{2,3}

The signs of carious demineralization are seen on the hard dental tissues, but the dis-

ease process is initiated within the bacterial biofilm (dental plaque) that covers a tooth surface.⁴ The susceptibility of teeth to caries relies upon various factors. It was discovered that susceptibility to caries rises unexpectedly to the maximum rate about a few years post-eruption. In 1941 Klein and Palmer were the first to describe the relative susceptibility to dental caries of various morphological tooth types.⁵

Individual tooth surfaces have vastly different susceptibilities to caries, with the pit and fissure (occlusal) surfaces the most susceptible, and the smooth (labial and lingual) surfaces the least susceptible and the most frequent sites of attack are the occlusal surfaces of the first and second permanent molars.⁶

Many studies have also shown that the various tooth types and surfaces showed variable vulnerability to dental caries, such site variability has been linked to many factors which include: (a) tooth anatomical configuration e.g., pit and fissures, (b) the volume of saliva, and (c) the type of bacterial ecology at the sites. In addition, it was reported that neighboring proximal tooth surfaces differ in their caries susceptibility, but the proximal lesions in adolescent and young adults remain to be high, even in low-risk populations. Information on surface-specific dental caries patterns is a useful source in deciding which preventive strategies to

use.^{3,5,6}

Different age groups and populations exhibit distinct caries prevalence rate observations which could provide a useful descriptive measure of caries susceptibility on the tooth surface. Older adults, have considerably more factors that place tooth surfaces at risk for caries than do younger adults; due to the many health conditions faced by this population during the later face of life, which can last as long as 40 years. During that period, the elderly faces a wide spectrum of oral and general health problems.⁶

Older adults are at increased risk for root caries because of both increased gingival recession that exposes root surfaces and increased use of medications that produce xerostomia, approximately 50% of

persons older than 75 years of age have root caries affecting at least one tooth.⁷ In conjunction with the environmental and genetic risk factors, sex also affects susceptibility to caries, in which females are at higher risk and have greater numbers of affected tooth surfaces compared to males, The causes of sex differences in dental caries experience are not fully understood, also possible explanations include earlier tooth eruption in females.^{2,6}

As well as sex differences in dietary and oral hygiene behaviors, utilization of oral health care, hormones, and characteristics of saliva. The differential actions of genes in men and women also have been proposed and such genetic effects are called gene-by-sex interactions.⁶ The current study was carried out to investigate in detail the distribution of caries on individual permanent tooth surfaces. This study also compared these results among various age groups and gender.

Methods

This is a retrospective cross-sectional study of thousand filled teeth taken from the patients attending the Conservative Department of College of Dentistry training clinic/Hawler Medical University in Erbil Governorate, Kurdistan region, Iraq was examined between 4th Sep. 2021 to 23rd Dec. 2021 to investigate the incidence of dental caries, and their distribution according to age and gender.

The data was collected from the case sheets of patients at the Conservative department, after the department's permission. The data collected included: Age, Gender, Tooth quadrant and number, G. V. Black classification and the type of restoration material. In this study, 1000 carious teeth were recorded of all individuals that sought for treatment in the conservative department in that period, there could be more than one carious tooth that has been recorded from a single individual, and furthermore the age and gender of the patients were recorded for each carious tooth. Individuals who reported being over the age of 12 years old as the patients below this age attended the pedodontics department. Patients were classified according to their age into 4 groups; group I (12-19 Y/A); group II

(20-39 Y/A); group III (40-59 Y/A); group IV (60Y/A and above).

According to the department's patient treatment protocol, the patients were initially examined in the Department of Diagnosis and Oral Medicine, and the second examination of the carious teeth was performed in the Conservative Department, which classified them by using G.V. Black classification into six classes. 1000 samples of carious teeth that were included in this study (546 of females, 454 of males), were examined according to WHO criteria on a dental chair in artificial light by using a plain mouth mirror and a dental probe.

Frequency distributions of incidence of caries on tooth surfaces were obtained using the SPSS statistics version 25 (IBM SPSS version 25). Chi-square statistics were used to examine the associations of incidence of caries on tooth surfaces with both age and gender.

Result

A total of 1000 samples of carious teeth were recorded and analyzed, which 546s. (54.6%) were from females and 454s. The incidence of dental caries on tooth surfaces according to G.V. Black classification is shown in figure 1. The incidence of Class I dental caries (45.4%) from males. The individuals participated aged between 12 to 70 years old with a mean age of 27.83 with ± 12.79 standard deviations. demonstrated the highest caries frequencies, with 322s. (32.2%), followed by Class II dental caries with 254s. (25.4%). While Class V and Class VI were significantly much less than the rest, which was 72s., 2s. respectively.

Out of 1000s., that were recorded in this study, 658s. were restored with composite, while 342s. were restored by Amalgam. Table 1 provides the frequencies, percentages and differences in caries incidence in maxillary and mandibular arch and quadrants. Teeth in maxillary arch 541s. (54.1%) reported greater levels of incidence of caries with a significant difference ($p=0.001$) than the mandibular arch teeth 459s. (45.9).

Regarding the distribution of caries within individual teeth as shown in Ta-

ble 2, the mandibular 1st Molar followed by the maxillary central incisor reported the highest levels of incidence of caries, with 185s. (18.5%) and 184s. (18.4%) respectively, while maxillary 3rd molar 2s. (0.2%) were least susceptible then mandibular central incisor 3s. (0.3%).

Figure 2. Shows the incidence of caries according to age group, the incidence of caries experience was different between age groups, which was the highest among individuals of group II, followed by a group I and group IV had the lowest incidence rate

Figure 3. Shows the distribution of caries according to the surfaces in female and male individuals. Females showed a higher incidence (54.6%) of caries than males (45.4%). When analyzing data aggregated by gender, there was no significant difference in the distribution of caries between males and female, in both groups class I and class II demonstrated higher rates of caries.

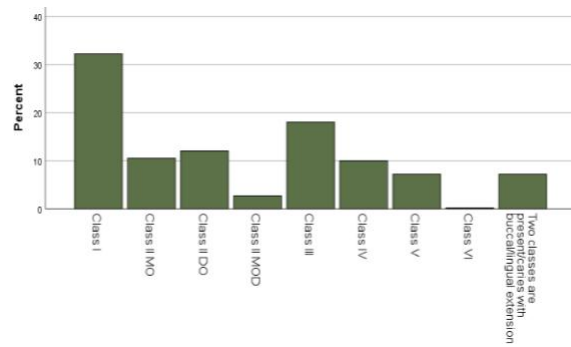


Figure 1: The incidence rate of G.V. Black classification.

Table 1: Incidence of caries within arches and quadrants.

	Right side	Left side	Total
Maxilla	263(26.3%)	278(27.8%)	541(54.1%)
Mandible	227(22.7%)	232(23.2%)	459(45.9%)
Total	490(49.0%)	510(51.0%)	1000

Table 2: Caries distribution on individual teeth based on G.V. black classification.

G.V. Black c.	Central incisor			Lateral incisor			Canine			First premolar			Second premolar		
	Max.	Man.	Total	Max.	Man.	Total	Max.	Man.	Total	Max.	Man.	Total	Max.	Man.	Total
Class I	0	0	0	3	0	3	0	0	0	3	5	8	11	17	28
Class II	0	0	0	0	0	0	0	0	0	36	10	46	32	35	57
Class III	101	1	102	55	6	61	13	3	17	0	0	0	0	0	0
Class IV	67	2	69	20	5	25	4	2	6	0	0	0	0	0	0
Class V	14	0	14	14	3	17	9	8	17	1	5	6	0	4	4
Class VI	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Two classes / buccal or lingual extension	2	0	2	4	0	4	0	0	0	1	1	2	1	4	5
Total	184	3	187	96	14	110	27	13	40	41	22	63	44	60	104

G.V. Black c.	First molar			Second molar			Third molar		
	Max.	Man.	Total	Max.	Man.	Total	Max.	Man.	Total
Class I	45	96	141	32	99	131	1	10	11
Class II	35	57	92	14	30	44	0	2	2
Class III	0	0	0	0	0	0	0	0	0
Class IV	0	0	0	0	0	0	0	0	0
Class V	2	3	5	0	8	8	1	0	1
Class VI	0	1	1	0	0	0	0	0	0
Two classes / buccal or lingual extension	14	28	42	5	12	16	0	1	1
Total	96	185	281	51	149	200	2	13	15

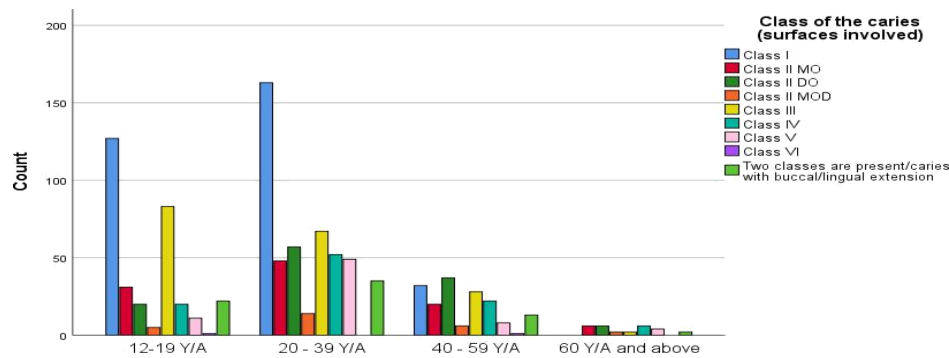


Figure 2: Distribution of caries among age groups.

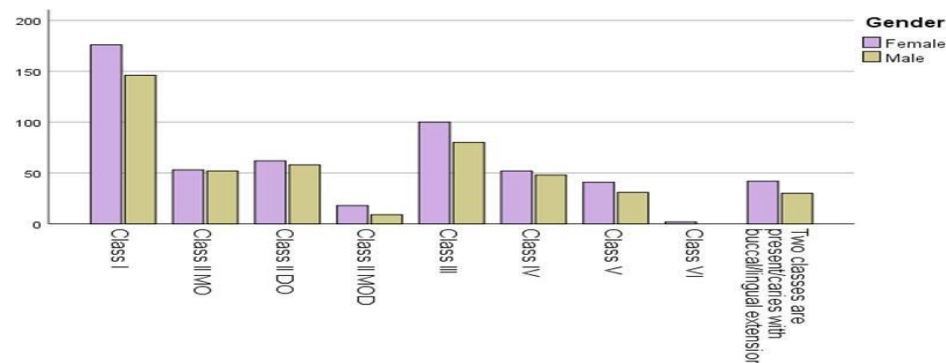


Figure 3: Caries incidence among gender based on G.V. Black classification

Discussion

The present study was based on determining the rates and incidence patterns of caries on individual tooth surfaces. Therefore, examinations for the present study were conducted only on patients who applied to the clinic for treatment of their caries teeth. Tooth or tooth surfaces were only recorded on case sheets, also indicating age and gender, as decayed when cavitation was obvious.

In the current study, when inter-arch comparison was done the incidence of dental caries was higher in the maxillary arch (541s.) than mandibular arch (459s.) Figure 4.



Figure 4: Incidence of dental caries in maxillary and mandibular arches.

Similar findings were reported by Al-darwish, that the study was conducted in Qatar among children aged 12-14 years.⁸ Nonetheless, a study done by Sachdeva, reported a higher caries incidence in mandibular arch.⁹ Otherwise, in the present study; the mandibular molars (347s.) were the most severely affected than the maxillary molars(149s.). Togoo found mandibular first molar exhibited a statistically significant higher incidence of caries than the maxillary counterpart in 7-10 years school going boys in Saudi Arabia, which may be explained by the earlier eruption of mandibular molars than maxillary molars and attributed to greater food and accumulation potential^{10,11}. Mandibular central incisors(3s.) along with maxillary third molars (2s.) were least commonly to be carious teeth, but generally third molars are less likely indicated for restoration, and less likely to be referred to the conservative department, so this could be the reason for less recording of the third molar as a carious tooth in this study. Mandibular molars were more prone to caries than incisors, canines, or premolars in all age groups. These results of the current study confirmed the findings

of Luan et al, who evaluated a ten-year incidence of dental caries in adult and elderly Chinese patients.¹² In the present study the mandibular first molar had the most susceptibility to caries (185s.), beside of its early eruption, the cause may be that a very special landmark on the mandibular first molars is present which is the mesiobuccal groove, it is a sort of sulcus that stretches from the occlusal surface to the buccal surface, and is frequently neglected during dental exams. Although sometimes rather shallow, this narrow groove can harbor a small but active bacterial community which can easily provoke cavitation.¹³ Maxillary central incisors (184s.) were the second most recorded after mandibular first molar, and the reason could be due to increased demand for aesthetics, suggestive of restorative needs and reasons of restoration failure other than caries and trauma.¹⁴ It was found that the most common caries lesions based on G.V. Black's classification was; Class I (322s.,32.2%), followed by Class II (252s., 25.2%), Class III (180s.,18.0%), Class IV (100s., 10.0%), Class V (72s., 7.2%) and the last was class VI (2s.,0.2%). A similar study was done by Hong and his coworkers in Bandung, Indonesia, in several cases, their findings were similar to ours, which were; Class I (62, 37.1%), Class III (37, 22.2%), Class II (34, 20.4%), Class V (22, 13.2%) and Class IV (12, 7.2%).¹⁵

Conventionally, the high incidence of caries on occlusal surfaces (Class I) has been directly related to the narrow and inaccessible pits and fissures. Klein and Palmer were the first investigators to clearly describe relationships between dental caries and the various morphological tooth types, they described that occlusal surface irregularities can facilitate biofilm development and eventually result in carious lesions. Depressions and grooves in the teeth are always anatomical points of concern for dental caries.⁵ The sulci of human teeth are generally V-shaped, and though in most cases, the toothbrush bristles can remove a good portion of biofilms in this area, certain debris and microbial

biofilm will remain attached to the deeper parts of the sulcus. The pit formed by the junction of developmental grooves is a very interesting anatomical feature in the molar occlusal surface, a very "tricky" area for dental caries on the occlusal surface in most hidden caries cases, a tiny open cavity is located between grooves. Basically, the point occurs at the convergence of occlusal surface ridges that terminate at a central point at the bottom of the depression. It is a junction of grooves, also regarded as a small physiological-anatomical depression, and easy to verify as an attractive location for bacterial growth. This makes sense of the great prevalence of Class I caries¹³. Proximal surfaces (which were recorded as Class II on the posterior teeth, and Class III on the anterior teeth), which are in a close or direct contact with the gum, were the second in turn (after the occlusal surfaces), of the most exposed places to the carious process. These surfaces are naturally protected from the influence of chewing forces, tongue movements and saliva flow, which contributes to the deposit of bacterial plaque and food debris in the spaces between adjacent teeth, and the non-possibility of natural self-cleaning of these places. Changes in the structure of the surface by the loss of the enamel smoothness due to the development of caries, or restorations with overhanging (extending) edges, additionally, create conditions for the retention of plaque and reduce the possibility of its proper removal. As a result, there is an accumulation of plaque, and subsequently, bacterial succession and dental caries.¹⁶

Class V and Class VI recorded a lesser prevalence of dental caries respectively and this agree with study done by Santi and kkkk

Subbarao¹⁷, Cervical caries (Class V) are found commonly in older age people. This is due to the physiological gingival recession at older age leaving the root surface exposed to the oral environment. The root surface is rougher than enamel and readily allows plaque formation in the absence of good oral hygiene. The cementum covering the root surface is extremely thin and provides little resistance to caries attack. Cuspid surface in this research includes incisal edge of the anterior teeth (Class IV) and the cusp tip regions of the posterior teeth (Class VI). However, from the data collected, there were only two cases with Class VI caries. Class IV is caused by attrition and fracture rather than caries which explain the high occurrence of class IV.¹⁵

This study showed that group II (20-39Y/A) had the highest rate of caries incidence for all classes of G.V.Black classification except for class III which was the highest rate of incidence among group I (12-19Y/A), and this finding corresponds with the study that carried out by Kamberi, the high caries incidence could be due to the dietary habits in this age group, because this group of people possibly likes to snack between meals on cariogenic sweet foods or high sucrose, age group could be another reason,^{18,19}

The present study showed that females have more caries than males; the percentages were 54.6% and 45.4% respectively. The finding that more carious teeth were observed in females than in males is in agreement with the findings of other studies^{20,21}. In general, permanent teeth erupt earlier in females than in males. As they are exposed to the risk of caries for a longer period, it is logical to assume that females' teeth would decay more than the teeth of their males' counterparts of the same age. The composition and flow rate of saliva in the host oral environment seems to be another source of susceptibility to caries formation in women. However, the flow rates of saliva and compositional analysis have been shown to be generally less protective in women than in men.²² Women during pregnancy have negative effects on the immune system (immune suppression) and salivary flow

(less salivary flow). Women have food cravings, variations in immune response, and aversions during pregnancy. Female sex hormones and associated physiological factors can significantly affect cavity formation. Evidence from animal models suggests that female estrogens, but not male androgens, correlate with caries rates. It is possible that there is a cumulative effect of estrogens, including fluctuations at puberty and high levels during pregnancy, which promotes caries.^{20,23}

Conclusion

- Caries incidence was higher in maxillary teeth than mandibular teeth.
- Caries incidence was higher in the mandibular molars than maxillary molars, and was higher in maxillary incisors than mandibular incisors.
- Caries incidence was the highest in the mandibular first molar.
- Class I (occlusal surface) caries had the highest incidence rate.
- Age (20-39Y/A) was the most susceptible age group to caries occurrence.
- Females appear to experience higher caries rates throughout life than males.

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