

## Secondary Caries in the Posterior Teeth of Patients Presenting to the Department of Operative Dentistry, Shahid Beheshti Dental School

<sup>1</sup>Zahra Jaberi Ansari <sup>\*2</sup>Haleh Valizadeh Haghi

<sup>1</sup>Associate Professor, Dept. of Restorative Dentistry, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

<sup>\*2</sup>Assistant Professor, Dept. of Restorative Dentistry, School of Dentistry, Ardebil University of Medical Sciences, Ardebil, Iran. E-mail: hvh\_haleh@yahoo.com

### Abstract

**Objective:** Secondary caries is a common problem in dental treatments and its occurrence is attributed to several factors. The present study aimed at assessing the prevalence of secondary caries in posterior teeth of patients presenting to the Department of Operative Dentistry, Shahid Beheshti Dental School.

**Methods:** This descriptive study was conducted on 350 patients with 1,339 posterior teeth restored with amalgam or composite resin. Restorations older than 3 years were evaluated. Data regarding presence or absence of secondary caries, age of restoration, location of receiving dental care, tooth brushing technique and use of dental floss and mouthwash were recorded in a questionnaire. Statistical analysis was done using chi-square test.

**Results:** The prevalence of secondary caries was 26% among the understudy patients. Mesio Ocluso Distal restorations (19.2%) had the highest prevalence of secondary caries. Composite restorations had higher prevalence of secondary caries compared to amalgam restorations ( $p=0.01$ ). Teeth restored in private dental offices had a higher prevalence of secondary caries compared to those restored in university clinics ( $p=0.007$ ). Patients who used mouthwash had a significantly lower prevalence of caries recurrence ( $p=0.05$ ).

**Conclusion:** The prevalence of secondary caries in patients presenting to the Department of Operative Dentistry of Shahid Beheshti Dental School was higher in the MOD restorations, composite restorations and teeth restored in private dental offices finally it was less in the patients using mouthwash.

**Key words:** Amalgam, Composite resin, Mouthwash, Prevalence, Private office, Restoration, Secondary caries.

Please cite this article as:

Jaberi Ansari Z, Valizadeh Haghi H. Secondary Caries in the Posterior Teeth of Patients Presenting to the Department of Operative Dentistry, Shahid Beheshti Dental School. *J Dent Sch* 2014; 32(3): 125-131.

Received: 22.06.2013

Final Revision: 04.02.2014

Accepted: 11.03.2014

### Introduction:

Dental caries is an infectious disease that leads to the destruction and demineralization of mineralized tooth structure and can progress from a primary state to a clinical cavity on smooth tooth surfaces within  $18\pm 6$  months (1).

According to G.V. Black, secondary caries is the re-development or recurrence of caries at restoration margins (2) that occurs following micro leakage or inadequate removal of primary caries (3). Exchange of restorations comprises about 75% of operative dental procedures and is

claimed to be done due to the presence of secondary caries (4).

Presence of secondary caries is the reason for the 50-55% of amalgam restoration exchanges (5). This rate has reported to be as high as 72% in another study (2). In a study by Mjör, *et al.* (2011), clinical diagnosis of secondary caries was the main reason for replacement of all types of restorations (6). Initiation of caries is usually painless even after dentinal invasion until the lesion causes pulp irritation. Secondary carious lesions have to be identified early especially when active dentinal caries are present because

the carious lesion spreads faster in dentin than in enamel due to the higher susceptibility of dentin and its lower resistance to acid. At present, diagnostic methods for detection of secondary caries adjacent to amalgam restorations include clinical examination and visual observation at a dry and clean site under adequate lighting, palpation with a dental explorer, use of dental floss, and interpretation of radiographs obtained from the site (1). Detection of secondary caries becomes more challenging if they occur under amalgam restorations at areas with no clinical access or direct vision like the gingival margin (7).

Secondary caries occur at the plaque accumulation sites, for this reason margins of restorations are more involved (8). Based on a study, more than 80% of secondary caries occur at the gingival wall of Class II restorations (7). Most dentists use radiography to detect proximal caries and to confirm clinical examination results (9).

Radiography is an appropriate means for detection of carious lesions that are not clinically visible. Exchange of restorations due to suspicion of secondary caries is usually postponed until obtaining radiographic evidence (10). Among different radiographies, bitewing is more reliable than other techniques for detection of proximal caries since the beam passes parallel to the proximal wall of the restoration (11).

Clinical examination is not always reliable either and new carious lesions around restorations cannot be detected only through clinical examination. In clinical examination, secondary caries are suspected usually when the dental explorer tip gets caught up in restoration margins. At such situations, a differential diagnosis has to be made between the secondary caries and caries-free defective restoration margins (7).

Discoloration of restoration margins is not a reliable sign for presence of secondary caries either. In a study, it was demonstrated that only

24% of restorations with discolored margins had active carious lesion beneath their restoration (4).

Considering all the above, diagnosis of secondary caries is associated with false positive and false negative results and definitive diagnosis cannot be made based on clinical or radiographic examination alone.

On the other hand, evaluation of secondary caries and the effects of potential risk factors like the age of restoration, type of restorative material, and etc. can be helpful in further understanding of this phenomenon. Considering the mentioned issues and for the importance of having accurate statistics regarding the prevalence of secondary caries, the present study aimed to determine the prevalence of secondary caries in posterior teeth of patients presenting to the Operative Dentistry Department of Shahid Beheshti Dental School.

### Methods:

In this descriptive study data were collected through clinical and radiographic examination, interview and filling out the questionnaire specifically designed for this purpose. A total of 350 subjects presenting to the Operative Dentistry Department of Shahid Beheshti Dental School at 2012 that had posterior restorations and recent posterior bitewing radiographs were evaluated. Since we did not intend to unnecessarily expose patients to radiation without sufficient evidence of carious lesions we only selected patients who already had recent posterior bitewing radiographs. Sample size was calculated as 350 individuals using the following formula:

$$N = \frac{Z^2 P((1-P))}{d^2} \quad \text{where } d=0.03, z=1.96, \text{ and } p=0.09$$

Sampling was consecutive. Patients underwent a thorough dental examination. The teeth were dried and examined under dental unit light and direct vision using dental explorer. A questionnaire was filled out for each patient and

their radiographs were also evaluated on a negatoscope with no magnification. All clinical and radiographic data were recorded in a questionnaire.

On radiographic examination, any radiolucency next to restorations was considered as the secondary caries. In clinical examination, the diagnosis of secondary caries was made based on observation of chalky appearance, gray-brown discoloration, palpation by dental explorer (soft or coarse consistency) and cavitation at the tooth/restoration interface (1).

Patients who had clinical and radiographic signs of secondary caries were considered as “positive” cases.

The questionnaire contained demographic characteristics of patients including age and gender, the understudy posterior tooth number, type of restoration material (amalgam or composite resin), type of restoration (MO, MOD, DO, O), location of receiving dental treatment (private office, public clinic, university clinic), age of restoration (less than 5 yrs., 5 to 10 years, 10 years or more), technique of tooth brushing (Bass, Circular and scrub or modified Stillman), use of dental floss, use of mouthwash and dentist’s diagnosis based on radiographic and clinical examinations.

Data were analyzed using SPSS 14 software and chi square test. This study was approved by the Ethics Committee of Shahid Beheshti Dental University.  $p < 0.05$  was considered statistically

significant.

**Results:**

A total of 350 patients with a mean age of 33.22 (13) yrs. were evaluated including 230 females (65.7%) and 120 males (34.4%). Based on our definition of secondary caries, 25.2% of females (58 subjects) and 27.5% of males (33 subjects) were found to have secondary caries in clinical and radiographic examination. The difference between males and females in prevalence of secondary caries was not statistically significant ( $p=0.6$ ). Of 350 subjects, 91 had secondary caries which shows a prevalence of 26% among the understudy population.

Of a total of 1,339 restored teeth that were examined in this study, 53 (3.9%) only showed sign of secondary caries radiographically as radiolucency with no clinical signs; 34 restored teeth (2.5%) only showed secondary caries clinically and 129 teeth (9.6%) were diagnosed as having secondary caries both clinically and radiographically.

The prevalence of secondary caries based on the number of tooth in the two jaws listed in the table 1. Results showed that in the upper jaw the prevalence of secondary caries was higher in the second premolar ( $p=0.04$ ) and in the lower jaw it was higher in the first molar ( $p=0.04$ ).

**Table 1- Prevalence of secondary caries based on the number of tooth in the jaws**

Upper Jaw					
Tooth Number	4	5	6	7	8
Prevalence	8.6%	10.6%	6.9%	5%	5.7%
Lower Jaw					
Tooth Number	4	5	6	7	8
Prevalence	15.4%	9%	18.6%	4.6%	10.7%

In terms of the type of restorative material, of 1,339 teeth, 1,269 had amalgam and 70 had composite restoration. Of teeth restored with amalgam, 116 (9.1%) and of those restored with composite resin 13 (18.6%) had secondary

caries. Based on chi square test, composite restorations had a significantly higher prevalence of secondary caries ( $p=0.01$ ).

The prevalence of secondary caries based on the type of restorations showed in the table 2.

Prevalence of secondary caries was higher in the MOD restorations ( $p=0.0001$ ).

**Table 2- Prevalence of secondary caries based on restoration types**

Restoration Type	MO	MOD	DO	O
Prevalence	12%	19.2%	17.6%	2.7%

In all 19 occlusal restorations with secondary caries the location of secondary caries was in the occlusal surface. Of 46 DO restorations with secondary caries, the location of secondary caries was at the occlusal surface in 21.7%, and at the distal surface in the remaining 78.3% of the cases. Of 23 MO restorations with secondary caries, the location of secondary caries was at the occlusal surface in 30.4% and at the mesial surface in the remaining 69.6% of cases. Of 25 MOD restorations with secondary caries, the location of secondary caries was at the occlusal surface in 8%, at the distal surface in 80% and at the mesial surface in 12% of the cases.

In terms of the correlation between the prevalence of secondary caries and location of receiving dental treatment, of 350 patients, 334 remembered where they received their tooth restoration of which, 156 had received their restoration in private dental offices, 129 in university clinics and 49 in different public clinics. Of the mentioned numbers, 33.3% of those who had received their restoration in private offices, 17.1% of those received their

restoration in universities and 30.6% of those receiving their restoration in public clinics had secondary caries. Based on these data, prevalence of secondary caries was the highest among patients who restored their teeth in private offices and this difference was statistically significant ( $p=0.007$ ).

The understudy 350 samples were classified into three age groups of younger than 30 yrs., between 30 to 40 yrs. and over 40 yrs. Of 172 patients younger than 30, 21.5%, of 79 patients between 30-40 yrs. 29.1% and of 99 patients over 40 yrs. 31.3% had secondary caries. However, the difference between different age groups was not statistically significant ( $p=0.2$ ).

Of 350 patients, 339 recalled the exact time of receiving their restoration. Age of restorations was divided into three groups of less than 5 years, between 5 to 10 years and 10 years or longer. The prevalence of secondary caries based on the age of restoration listed in the table 3. The difference between groups were not statistically significant ( $p=0.2$ ).

**Table 3- Prevalence of secondary caries based on restoration age**

Restoration age	No.	Secondary Caries	Prevalence
Less than 5 Yrs.	135	31	23%
5-10 Yrs.	125	30	24%
10 Yrs. Or later	79	27	34.2%

In terms of technique of brushing no association was found between technique of tooth brushing and prevalence of secondary caries ( $p=0.4$ ). The data based on brushing techniques summarized in the table 4.

About the use of dental floss, 94 subjects stated that they regularly use dental floss. Of those using dental floss, 25.5% and of those not using it 26.3% showed secondary caries. The correlation between the use of dental floss and

**Table 4- Prevalence of secondary caries based on brushing techniques**

Brushing Technique	No.	Secondary Caries	Prevalence
Bass	43	11	25.6%
Circular and scrub	262	65	24.8%
Modified stillman	27	10	37%

prevalence of secondary caries was not statistically meaningful ( $p=0.2$ ).

In terms of using mouthwash, 23 used mouthwash out of which 2 (8.7%) showed secondary caries and 325 reported not using it of which 88 (27.1%) had secondary caries. Prevalence of secondary caries was significantly lower in subjects who used mouthwash ( $p=0.05$ ).

### Discussion:

Prevalence of secondary caries in this study conducted on 350 patients aged 12 to 67 years was found to be 26%. The teeth were diagnosed as having secondary caries if clinical and radiographic signs of secondary caries were present. In cases where the diagnosis is made based on clinical or radiographic examination alone, factors like radiolucency's due to causes other than caries (base material, arrested caries, etc.), two-dimensional view of the radiography, gaps at restorations margins, discolorations due to amalgam byproducts, absorption of stains by the tooth structure and personal errors may result in false positive or false negative diagnoses (3, 5, 9, 11- 14).

Chomyszyn-Gajweska, *et al.* (1992) in Poland reported the prevalence of secondary caries to be 12.3% (15). They only used clinical examination with dental mirror and explorer and considered any caught up of the tip of the explorer as secondary caries. Higher rate of secondary caries in their study compared to ours may be due to their technique of diagnosis because in this method, any gap at the restoration margin, marginal ditch or defects, small overhangs or restoration problems other than secondary caries may result in caught up of the explorer tip and be misdiagnosed as secondary caries. Similar to our study, they reported the higher prevalence of secondary caries in molar teeth.

Chestnutt, *et al.* (1995), in Scotland conducted a

study on 4,294 subjects aged 12 to 13 years. They reported the prevalence of secondary caries to be 8% during three years (16). This prevalence was lower than the value we obtained in our study. This difference may be attributed to the young age of understudy subjects and evaluation of recently restored teeth.

Otto and Rule (1988) in the US evaluated the prevalence of secondary caries in restored teeth. They only used bitewing radiographs and considered any radiolucency below the restoration as secondary caries. They showed that 10.7% of the restored teeth had secondary caries (17). This prevalence was higher than the value obtained in our study which may be due to the fact that radiolucencies below the restorations may not necessarily be a sign of secondary caries and can be due to the base/lining or any other radiolucent dental materials misdiagnosed as secondary caries in the mentioned study.

Fitzgerald, *et al.* (1994) in US reported the prevalence of secondary caries as 31% in restored teeth (18). They removed the restorations in the extracted teeth and evaluated the presence of secondary caries below them. The prevalence reported by them was greater than the value in our study which is attributed to the fact that some cases of secondary caries that revealed by direct inspection after the removal of the restorations failed to be diagnosed through radiographic and clinical examinations.

Composite restorations had a higher prevalence of secondary caries compared to amalgam restorations which may be related to the technical sensitivity of composite resin application, the necessity of complete isolation of the tooth and proper use of dentin bonding agents. It has been shown that cariogenic bacterial growth adjacent to a restoration is higher in a composite restoration compared to amalgam or glass ionomer restorations (19).

Prevalence of secondary caries in MOD

restorations was also higher than other restoration types in this study which can be due to the higher number of restoration surfaces susceptible to micro leakage in MOD restorations. Secondary caries often reported at the gingival margins of class II and class V restorations (20).

Prevalence of secondary caries in patients presenting to private offices was greater than in those presenting to public clinics or universities which may be attributed to the thorough supervision of the students' performance in the university by the experts and experienced instructors. Koletsi-Kounari, *et al.* (1989) showed that restorations done at the university clinics were significantly of higher quality than the ones done at the public and private clinics (21).

Patients who were not using mouthwash had a significantly higher prevalence of secondary caries in our study. However, no significant differences were found between the prevalence of secondary caries based on the technique of tooth brushing and use of dental floss. Considering the simple use of mouth wash and the possibility of improper use of dental floss or incorrect brushing by the patients, these results

can be explained. Goldberg in his study found that oral hygiene had a more significant effect on risk of recurrent caries under restorations with moderate margin scores compared to those with very poor or very good cavo surface margins (22).

Silva, *et al.* (2010) evaluated the association of secondary caries with the presence of marginal defects and concluded that secondary carious lesion usually initiate at the interface of tooth/restoration (23).

### **Conclusion:**

The present study demonstrated that prevalence of secondary caries was higher in MOD restorations, composite restorations and teeth restored in private dental offices. Patients using mouthwash had a significantly lower prevalence of caries recurrence. No significant association was detected between secondary caries and gender, age, technique of tooth brushing and use of dental floss.

### **Conflict of Interest: "None Declared"**

### **References:**

1. Heymann HO, Swift EJ, Ritter AV. Sturdevant's art and science of operative dentistry. 6<sup>th</sup> Ed. St.Louis: The C.V. Mosby Co. 2013; Chap 2: 41-88.
2. Mjor IA, Toffenti F. Secondary Caries, A literature review with case reports. Quintessence Int 2000; 31: 165-179.
3. White SC, Pharoah MJ. Oral Radiology, principle and interpretation. 4<sup>th</sup> Ed. St. Louis: The C.V. Mosby Co. 2000; Chap 15: 241-253.
4. Kidd EA, Joyston-Bechal S, Beighton D. Diagnosis of secondary caries: a laboratory study. Br Dent J 1994; 176: 135-139.
5. Foster LV. Validity of clinical judgments for the presence of secondary caries associated with defective amalgam restorations. Br Dent J 1994; 1: 89-93.
6. Mjör IA, Moorhead JE, Dahl JE. Reasons for replacement of restorations in permanent teeth in general dental practice. Int Dent J 2011; 50: 361-366.
7. Mjör IA. The location of clinically diagnosed secondary caries. Quintessence Int 1998; 29: 313-317.

8. Kidd E. Diagnosis of secondary caries. *J Dent Educ* 2001; 65: 997-1000.
9. Espelid I, Tveit AB. Diagnosis of secondary caries and crevices adjacent to amalgam. *Int Dent J* 1991; 41:359-364.
10. Hewlett ER, Atchison KA, White SC, Flack V. Radiographic secondary caries prevalence in teeth with clinically defective restorations. *J Dent Res* 1993; 72: 1604-1608.
11. Kandemir S. The radiographic investigation of the visibility of secondary caries adjacent the gingiva in class II amalgam restorations. *Quintessence Int* 1997; 28: 387-392.
12. Roberson TM, Heymann HO, Swift Ej. *Art and science of operative dentistry*. 4<sup>th</sup> Ed. St. Louis: The C.V. Mosby Co. 2002; Chap 3: 63-130.
13. Kidd EA. Caries diagnosis within restored teeth. *Adv Dent Res* 1990; 4: 10-13.
14. Magalhães CS, Freitas AB, Moreira AN, Ferreira EF. Validity of staining and marginal ditching as criteria for diagnosis of secondary caries around occlusal amalgam restorations: an *in vitro* study. *Braz Dent J* 2009; 20: 307-313.
15. Chomyszyn-Gajweska M, Knyszalska-Karwan Z, Fijal D, Franaszek E, Gawrzewska B, Kaczmarczyk- Stachowska A, *et al*. Prevalence of recurrent caries in three adult communities in Poland. *Community Dent Oral Epidemiol* 1992; 20: 311.
16. Chestnut G, Jones R, Jacobson PM, Schäfer F, Stephen KW. Prevalence of clinically apparent recurrent caries in Scottish adolescents and influence of oral hygiene practices. *Caries Res* 1995; 29: 266-271.
17. Otto PF, Rule JT. Relationship between proximal cavity design and recurrent caries. *J Am Dent Assoc* 1988; 116: 867-870.
18. Fitzgerald RJ, Adams Bo, Davis ME. A microbiological study of recurrent dentinal caries. *Caries Res* 1994; 28: 409-415.
19. Summitt J, William Robbins J, Hilton T, Schwartz R, Santos J. *Fundamentals of operative dentistry a contemporary approach*. 3<sup>rd</sup> Ed. Chicago: Quintessence Publishing Co. 2006; Chap 2: 37-67.
20. Mjor IA. Clinical diagnosis of recurrent caries. *J Am Dent Assoc* 2005; 136: 1426-1433.
21. Koletsi-Kounari H, Mamai-Homata E, Apostolopoulos A. Quality assessment of fillings by place and type of provider. *Hell Stomatol Chron* 1989; 33: 93-99.
22. Goldberg J, Tanzer J, Munster E, Amara J, Thal F, Birkhed D. Cross-sectional clinical evaluation of recurrent enamel caries, restoration of marginal integrity and oral hygiene status. *J Am Dent Assoc* 1981; 102: 635-641.
23. Silva B, Heller D, Maltz M. Characteristics of secondary caries lesion around composite resin restorations. *Revista da Faculdade de Odontologia de Porto Alegre* 2010; 51: 23-29.