

# Surface characteristics and lesion depth and activity of suspicious occlusal carious lesions

## Findings from The National Dental Practice-Based Research Network

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**S**uspicious occlusal carious lesions (SOCLs) can be characterized as initial carious lesions on occlusal tooth surfaces that have no cavitation and no radiographic evidence of caries but in which the presence of a carious lesion is suspected owing to roughness, surface opacities, or staining. Such lesions may be

difficult to detect<sup>1-5</sup> and often present a

diagnostic challenge because of the difficulty in determining if the lesion has penetrated into dentin.<sup>3,6,7</sup> Commonly, noninvasive therapies (fluoride, sealant) are recommended when lesions are confined to enamel or when dentinal lesions are inactive, whereas invasive treatments, such as preventive resin restorations or full restorations, are reserved



Supplemental material is available online.

### ABSTRACT

**Background.** A lesion on an occlusal tooth surface with no cavitation and no radiographic radiolucency but in which caries is suspected owing to surface roughness, opacities, or staining can be defined as a suspicious occlusal carious lesion (SOCL). The authors' objective was to quantify the characteristics of SOCLs and their relationship to lesion depth and activity after these lesions were opened surgically.

**Methods.** Ninety-three dentists participated in the study. When a consenting patient had an SOCL, information was recorded about the tooth, lesion, treatment provided, and, if the SOCL was opened surgically, its lesion depth. The Rao-Scott cluster-adjusted  $\chi^2$  test was used to evaluate associations between lesion depth and color, roughness, patient risk, and luster.

**Results.** The authors analyzed 1,593 SOCLs. Lesion color varied from yellow/light brown (40%) to dark brown/black (47%), with 13% other colors. Most (69%) of SOCLs had a rough surface when examined with an explorer. Over one-third of the SOCLs (39%) were treated surgically. Of the 585 surgically treated SOCLs, 61% had dentinal caries. There were statistically significant associations between lesion depth and color ( $P = .03$ ), luster ( $P = .04$ ), and roughness ( $P = .01$ ). The authors classified 52% of the patients as being at elevated caries risk. The authors found no significant associations between lesion depth and patient risk ( $P = .07$ ).

**Conclusions.** Although statistically significant, the clinical characteristics studied do not provide accurate guidance for making definitive treatment decisions and result in high rates of false positives.

**Practical Implications.** Given that 39% of the opened lesions did not have dentinal caries or were inactive, evidence-based preventive management is an appropriate alternative to surgical intervention.

**Key Words.** Evidence-based dentistry; carious lesions; dentin.

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for active lesions that have penetrated into dentin.<sup>8,9</sup> In the event of uncertainty, noninvasive treatments are recommended because the proportion of these lesions that progress is small, and progression is seldom rapid.<sup>8,10,11</sup> Ismail and colleagues<sup>12</sup> found that although general dentists spend the bulk of their time restoring lesions, there is a growing interest in the preventive aspects of managing these lesions. It is important to gather evidence from ongoing research studies that further evaluate the characteristics of SOCLs and diagnostic, management, and treatment strategies to develop guidelines that can help dentists treat their patients and manage their oral health. Providing the appropriate care for these lesions may reduce the number of invasive procedures being performed. This is important because invasive treatment initiates the almost-inevitable reresoration cycle.<sup>13</sup>

Although SOCLs pose diagnostic difficulty and uncertainty, little descriptive information is available. To our knowledge, only 1 study has been conducted to estimate the prevalence of SOCLs, and it was conducted by The National Dental Practice-Based Research Network (“network”).<sup>14</sup> The authors of this study suggested that SOCLs are commonly encountered in daily clinical practice, with approximately one-third of patients exhibiting such lesions at a given time. On average, practitioners saw 55 patients a month with an unrestored occlusal surface, which translated into approximately 19 SOCLs encountered per month. In addition, the same authors found that almost one-half of the lesions for which practitioners performed invasive procedures did not penetrate clinically into dentin.<sup>15</sup> Although most of dentists in the network subscribe to the “restorative threshold” of caries penetrating into dentin, their ability to detect preoperatively when this penetration has occurred is not optimal.<sup>16</sup> Given the high prevalence of SOCLs and the scarcity of descriptive information about them, gaining a better understanding of these lesions is essential for informed decision making regarding treatment. We conducted this study to quantify the characteristics of SOCLs and their relationship to caries risk and lesion depth and activity, as judged by clinicians’ reports after they surgically opened these lesions.

## METHODS

The results we present here were generated as a part of a larger study conducted in dental practices in the network. The network is a consortium of dental practices established to answer questions raised by dental practitioners in everyday clinical practice and to evaluate the effectiveness of strategies to prevent, manage, and treat oral diseases and conditions.<sup>17,18</sup>

**Selection and recruitment process.** Network practitioners were recruited by regional coordinators through letters and announcements sent to licensed practitioners from all 6 network regions (Western, Midwest, Southwest,

South Central, South Atlantic, and Northeast). To be eligible for this study, practitioners had to complete an enrollment questionnaire, attend an orientation session or watch a video of it, and complete their training in the protection of human participants. The enrollment questionnaire, which is publicly available at <http://nationaldentalpbrn.org/enrollment.php>, collects information about practitioner, practice, and patient characteristics. Once practitioners had completed the required steps, the regional coordinators provided training sessions with the practitioners and staff that included an overview of the study and steps to complete the necessary forms and answered any questions they had related to the study. The network’s applicable institutional review boards approved the study; all participants provided informed consent after receiving a full explanation of the procedures.

**Study design.** Network dentists (practitioners) collected the data in their offices. If patients had a SOCL on a permanent molar, were 6 years or older, and consented (or if a minor, assented, in conjunction with parental or guardian consent) to participate in the study, the practitioners completed data-collection and patient-characteristics forms using their typical examination procedures. These forms included specific information about the patients and lesions. Lesion characteristics queried included luster (chalky or shiny), color (opaque, white spot, yellow/light brown, dark brown/black, or other), and roughness of the surface with the use of an explorer (did not use an explorer, yes, or no roughness). Practitioners recorded patient risk factors, such as other teeth with carious lesions, restorations in the previous 3 years, visible heavy plaque, high cariogenic diet, inadequate saliva flow, and infrequent/unpredictable recall intervals. Practitioners then categorized their patients as at “low” or “elevated” caries risk. Practitioners then recorded the treatment plan for the suspected lesion, which could have included monitoring, oral hygiene instruction, fluoride (in-office or prescription), sealant with no preparation, enameloplasty, preventive resin restorations, or full restoration. Practitioners also indicated if the lesion was opened surgically, and if so, they recorded lesion depth (using the E0-E2, D1-D3 classification system<sup>19</sup>) and activity (E0 [no caries], inactive/arrested caries, active caries in the outer one-half of the enamel [E1], active caries in the inner one-half of the enamel [E2], active caries in the outer one-third of dentin [D1], active caries in the middle one-third of dentin [D2], or active caries in the middle one-third of dentin [D3]).

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**ABBREVIATION KEY.** **D1:** Active caries in the outer one-third of dentin. **D2:** Active caries in the middle one-third of dentin. **D3:** Active caries in the middle one-third of dentin. **E0:** No caries. **E1:** Inactive/arrested caries, active caries in the outer one-half of the enamel. **E2:** Active caries in the inner one-half of the enamel. **SOCL:** Suspicious occlusal carious lesion.

In addition, practitioners were provided sample photographs of SOCL lesions as well as examples of stepwise removal of SOCL lesions to illustrate how to determine maximum penetration into enamel or dentin. Each practice was asked to enroll approximately 20 lesions. Examples of the data collection forms are available at <http://nationaldentalpbrn.org/study-results/decision-aids-for-the-management-of-suspicious-occlusal-caries-lesions.php>.

**Statistical methods.** The Rao-Scott cluster-adjusted  $\chi^2$  test was used to evaluate associations between lesion depth and color, roughness, patient risk, and luster, accounting for clustering by dentist.

## RESULTS

**Practitioners and patients.** The participants included 93 dentists from all 6 network regions. As shown in Table 1, of these 93 practitioners, 34 were women, 69 were non-Hispanic white, and 69 graduated from dental school more than 15 years before the study. There was a fairly equal distribution of practitioners per region, ranging from 13 in the Western region to 18 in the South Central region.

As shown in Table 1, 72% of the patients were 19 years or older, with a mean (standard deviation) age of 32 (17) years. More than one-half, 943 (59%), were female. Most, 1,114 (75%), were non-Hispanic white, and 1,337 (87%) had dental insurance. Among those 19 years or older, approximately one-third had some college education or a bachelor's degree.

**Teeth and lesions.** Overall, practitioners recorded data for 1,593 lesions. As shown in Table 2, 1,018 lesions (64%) involved molars, 852 (53%) had a chalky luster as opposed to a shiny; 751 (47%) were dark brown/black as opposed to yellow/light brown, opaque, or white spot; and 1,096 (69%) had a rough texture as opposed to smooth. As also shown in Table 2, 991 patients (62%) did not have caries risk factors such as heavy plaque, cariogenic diet, infrequent recall, or xerostomia. Almost all the lesions were diagnosed using an explorer or by air-drying ( $n = 1,534$ ; 96%), and most were diagnosed using magnification ( $n = 1,065$ , 67%). Specific treatment for the SOCL included monitoring ( $n = 906$ , 38%), oral hygiene instruction ( $n = 487$ , 21%), and a full restoration ( $n = 362$ , 15%). When categorized by invasive versus noninvasive treatment received, less than one-half ( $n = 612$ , 39%) of the lesions were treated through invasive means (sealant with tooth structure altered, enameloplasty, preventive resin restoration, or full restoration).

**Treatment planned and corresponding lesion depth.** For lesions receiving invasive treatment, there was a general pattern of more invasive planned treatment for lesions that were found to be deeper when opened (Table 3). Nearly three-quarters of D1-D3 lesions had been planned for a full restoration, in contrast to 41% of E1-E2 lesions and 13% of inactive/arrested lesions and no

TABLE 1

### Practitioner and patient characteristics.

CHARACTERISTICS	NO. (%) <sup>*</sup>
<b>Practitioners (N = 93)</b>	
<b>Sex</b>	
Male	59 (63)
Female	34 (37)
<b>Race</b>	
Non-Hispanic white	69 (75)
Non-Hispanic black	7 (7)
Other	16 (18)
<b>Years since graduation</b>	
< 5	6 (7)
5-15	18 (19)
> 15	69 (74)
<b>Region</b>	
Western	13 (14)
Midwest	14 (15)
Southwest	17 (18)
South Central	18 (19)
South Atlantic	16 (17)
Northeast	15 (16)
<b>Patients (N = 1,593)</b>	
<b>Age, Y</b>	
< 19	443 (28)
≥ 19	1,147 (72)
Mean (standard deviation) age	32 (17)
<b>Sex</b>	
Male	650 (41)
Female	943 (59)
<b>Race</b>	
Non-Hispanic white	1,114 (75)
Non-Hispanic black	237 (16)
Other	125 (8)
<b>Any dental insurance?</b>	
Yes	1,337 (87)
No	207 (13)
<b>Education<sup>†</sup></b>	
Less than high school diploma	20 (2)
High school graduate	149 (13)
Some college	393 (34)
Bachelor's degree	368 (32)
Graduate degree	205 (18)
Decline to answer	12 (1)
<sup>*</sup> Data are no. (%) except for mean age of patients, which shows the standard deviation in parentheses. Some columns do not total 1,593 due to missing values.	
<sup>†</sup> For those ≥ 19 years of age.	

detectable lesions. Preventive resin restorations were more commonly planned for these latter lesions and for E1-E2 lesions (53% for both groups) compared with 15% of D1-D3 lesions so planned.

TABLE 2

<b>Tooth, lesion, risk factor, diagnostic, and treatment characteristics.*</b>	
<b>CHARACTERISTIC</b>	<b>NO. (%)</b>
<b>Teeth and Lesions (N = 1,593)</b>	
<b>Tooth number</b>	
Molar	1,018 (64)
Premolar	575 (36)
<b>Luster</b>	
Chalky	852 (53)
Shiny	741 (47)
<b>Color</b>	
Yellow/Light brown	637 (40)
Dark brown/Black	751 (47)
Other	105 (13)
<b>Surface roughness</b>	
Yes	1,096 (69)
No	458 (29)
Did not use an explorer	39 (2)
<b>Patient Risk Factors</b>	
Heavy plaque	273 (17)
Cariogenic diet	268 (17)
Infrequent recall	28 (2)
Xerostomia	326 (21)
None of the above	991 (62)
<b>Overall Patient Risk Level</b>	
Low	1,039 (65)
Elevated	554 (35)
<b>Diagnostic Aids Used For This SOCL†</b>	
Dental explorer	1,534 (96)
Air drying	1,507 (95)
Magnification	1,065 (67)
Radiographs	942 (59)
<b>Specific Treatment Provided For SOCL‡</b>	
Monitor	906 (38)
Oral hygiene instruction	487 (21)
In-office fluoride	206 (9)
Prescription fluoride	78 (3)
Sealant (no preparation)	67 (3)
Enameloplasty	45 (2)
Preventive resin restoration	205 (9)
Full restoration	362 (15)
<b>Categorized Treatment Performed For SOCL*</b>	
<b>Noninvasive</b> (Monitor, Oral Hygiene Instruction, fluoride, sealant)	933 (61)
<b>Invasive</b> (Sealant that alters tooth structure, enameloplasty, preventive resin restoration, full restoration)	612 (39)
* Some columns do not total 1,593 due to missing values. † SOCL: Suspicious occlusal carious lesion. ‡ More than 1 choice was permitted, so column adds up to more than 1,593.	

The Appendix shows a comparison between practitioners' pretreatment estimates of the depth of the lesions ( $n = 1,593$ ) and the actual depth of the lesions treated invasively ( $n = 585$ ). For the lesions in which practitioners estimated the depth to be E1, 88% (555/638) were not opened; of those opened, 28% (22/[638-555-5]) were indeed E1 when opened. For lesions with an estimated depth of E2, 59% (241/[428-18]) were not opened; of those opened, 38% (64/[428-241-18]) were indeed E2 when opened. For lesions with preoperative estimates of depth at D1, 21% (71/[372-41]) were not opened; of those opened, 48% (126/[372-41-71]) did have an actual depth of D1.

**Lesion color/luster, roughness, risk, and lesion depth.** There were clinical descriptive data for 585 of the 612 lesions treated invasively (27 patients did not return for final treatment). As shown in Table 4, within these 585 lesions, there were statistically significant associations between lesion depth and color ( $P = .03$ ), luster ( $P = .04$ ), and roughness ( $P = .01$ ) but no statistically significant association between lesion depth and caries risk of the patient ( $P = .07$ ).

With respect to lesion color, of the 204 invasively treated lesions that were yellow/light brown, a little over one-half, 111 (54%), had caries into dentin. Conversely, of the 274 dark brown/black lesions that were opened, most 186 (68%), had caries into dentin. The color of opened lesions with caries limited to the enamel was more equally distributed across the 3 color categories.

With respect to lesion luster, of the 393 chalky lesions that were opened surgically, most 258 (66%), had caries into dentin. A little more than a one-half of the invasively treated shiny lesions, 101 of 258 (53%), had caries into dentin.

A large majority of the SOCL lesions in the study, 477 of 585 (82%), did have surface roughness. Of these 477 lesions with surface roughness that were opened, 307 (64%) had caries into dentin. This is in contrast with the 89 opened SOCLs that had no surface roughness in which 44 (49%) had dentinal caries.

As shown in Table 4, of the 585 patients with a SOCL that was opened surgically, about one-half, 305 (52%), were described by the practitioner as being at elevated caries risk. There was no significant association between the lesion depth and caries risk of the patient; of the 280 patients who had a lesion opened and who were described as low risk, 155 (55%) had caries into dentin compared with 204 (67%) patients who had a lesion opened and who were among the 305 in the elevated risk group.

## DISCUSSION

Dental care has slowly evolved from a time when all carious lesions, regardless of size, were restored to

TABLE 3

### Treatment planned\* and corresponding lesion depth for 589 lesions treated invasively.†‡

TREATMENT	NO CARIES	INACTIVE OR ARRESTED CARIES	E1	E2	D1	D2	D3	PATIENT DID NOT RETURN FOR TREATMENT
Enameloplasty (n = 36)	7 (37)	11 (27)	2 (5)	5 (4)	3 (2)	1 (1)	0 (0)	7 (14)
Preventive Resin Restoration (n = 186)	8 (42)	24 (58)	27 (63)	54 (49)	36 (26)	11 (9)	3 (9)	13 (27)
Full Restoration (n = 356)	2 (11)	6 (15)	13 (30)	49 (44)	128 (71)	99 (88)	31 (91)	28 (57)
Enameloplasty and Preventive Resin Restoration (n = 5)	1 (5)	0 (0)	1 (2)	1 (1)	2 (1)	0 (0)	0 (0)	0 (0)
Enameloplasty and Full Restoration (n = 1)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)
Preventive Resin Restoration and Full Restoration (n = 5)	1 (5)	0 (0)	0 (0)	1 (1)	0 (0)	2 (2)	0 (0)	1 (2)
<b>Total (n = 589)</b>	<b>19</b>	<b>41</b>	<b>43</b>	<b>110</b>	<b>180</b>	<b>113</b>	<b>34</b>	<b>49</b>

\* More than 1 treatment could be chosen.

† 35 lesions were indicated as not having been opened on the basis of Q12 ("When you treated the lesion, what did you find?") despite an invasive treatment chosen in Q11 ("I chose to treat the tooth today by...").

‡ Data are no. (%).

today's "early detection and management."<sup>8</sup> Diagnosing caries can be thought of as a process that involves 3 steps: detection, assessment of the severity, and assessment of the activity,<sup>20</sup> which will lead to an appropriate treatment plan. Assessment of severity and activity can be established on the basis of cues such as color, feel, and luster of the lesion<sup>21</sup> as well as the caries risk of the patient. Makhija and colleagues<sup>14</sup> studied 2,603 SOCLs in 82 practices. They found that most of the lesions were in molars (69%), about one-half were chalky (49%), approximately one-half were rough (45%), and most were dark in color (85%). The lesions in our study had a higher percentage with surface roughness (69%) and a lower percentage that were dark in color (47%). A recent meta-analysis of 30 observational studies including more than 18,000 practitioners found that many practitioners still were choosing invasive treatment of enamel occlusal lesions<sup>22</sup>; however, we found in our study that 61% of the lesions enrolled were treated noninvasively.

In Makhija and colleagues<sup>11</sup> study, the lesions were followed an average of 20 months, at which time clinicians continued to monitor 927 (90%) of the 1,033 monitored lesions, sealed 61 (6%), and invasively treated 45 (4%). This finding suggests that noninvasive treatment at baseline was appropriate for these lesions and is consistent with a longitudinal study conducted by Hamilton and colleagues,<sup>10</sup> a randomized trial that evaluated air abrasion as compared with monitoring in 223 SOCLs. After 2 years, only 16% of the lesions in the monitoring arm had caries that progressed into dentin requiring invasive treatment. This is evidence that, if done properly, noninvasive options such as sealants may be successful at arresting these types of lesions.<sup>23,24</sup>

There are some limitations with our current study, in which we investigated diagnosis and treatment as

delivered in routine, "real world" clinical practice and therefore made no attempt to standardize or calibrate that diagnosis or treatment. Each practice was trained specifically for this study so as to standardize the data-collection process, but no effort was made to standardize diagnostic or treatment methods for SOCLs. Indeed, such standardization would not have been desirable because an objective of the study was to determine the distribution of the characteristics of these lesions given the diagnostic methods that dentists use in routine practice. In addition, in contrast to previous studies that examined random samples of teeth, the teeth included in this study were selected because the practitioner determined that the characteristics of the tooth and patient suggested that the surface might have a lesion—hence the term "suspicious." Because this study was observational in nature, not all teeth were treated surgically, so the lesion depth of the unopened teeth could not be determined.

Network members are not recruited randomly, so factors associated with network participation (for example, an interest in clinical research) may make network dentists unrepresentative of dentists at large. Although we cannot assert that network dentists are entirely representative, we can state that they have much in common with dentists at large, while also offering substantial diversity in these characteristics. This assertion is warranted because

- substantial percentages of network general dentists are represented in the various response categories of the characteristics in the enrollment questionnaire;
- findings from several network studies document that network general dentists report patterns of diagnosis and treatment that are similar to patterns determined from nonnetwork general dentists<sup>25-30</sup>;

TABLE 4

<b>Overall color, luster, risk, surface roughness, and lesion depth for 585 lesions treated invasively.*</b>				
<b>LESION DEPTH</b>	<b>RESPONSE TO THE QUESTION "WHEN YOU OPENED THE LESION, WHAT DID YOU FIND?"</b>			
<b>No Caries</b>	22 (4)			
<b>Inactive Caries</b>	42 (7)			
<b>Enamel</b>	162 (28)			
<b>Dentin</b>	359 (61)			
<b>LESION COLOR</b>	<b>Yellow/Light Brown (n = 204)</b>	<b>Dark Brown/Black (n = 274)</b>	<b>Other† (n = 107)</b>	<b>P Value</b>
<b>No Caries</b>	12 (6)	3 (1)	7 (7)	
<b>Inactive Caries</b>	12 (6)	22 (8)	8 (7)	
<b>Enamel</b>	69 (34)	63 (23)	30 (28)	
<b>Dentin</b>	111 (54)	186 (68)	62 (58)	.03
<b>LESION LUSTER</b>	<b>Chalky (n = 393)</b>	<b>Shiny (n = 192)</b>		<b>P Value</b>
<b>No Caries</b>	14 (4)	8 (4)		
<b>Inactive Caries</b>	22 (5)	20 (10)		
<b>Enamel</b>	99 (25)	63 (33)		
<b>Dentin</b>	258 (66)	101 (53)		.04
<b>SURFACE ROUGHNESS</b>	<b>Did Not Use an Explorer (n = 19)</b>	<b>No (n = 89)</b>	<b>Yes (n = 477)</b>	<b>P Value</b>
<b>No Caries</b>	1 (5)	9 (11)	12 (3)	
<b>Inactive Caries</b>	1 (5)	10 (11)	31 (6)	
<b>Enamel</b>	9 (47)	26 (29)	127 (27)	
<b>Dentin</b>	8 (43)	44 (49)	307 (64)	.01
<b>PATIENT RISK</b>	<b>Low (n = 280)</b>	<b>Elevated (n = 305)</b>		<b>P Value</b>
<b>No Caries</b>	14 (6)	8 (3)		
<b>Inactive Caries</b>	26 (9)	16 (5)		
<b>Enamel</b>	85 (30)	77 (25)		
<b>Dentin</b>	155 (55)	204 (67)		.07

\* Data are no. (%) except for the P values.  
† "Other" includes opaque, white spot, and all descriptions other than yellow/light brown or dark brown/black.

■ the similarity of network dentists to nonnetwork dentists has been established, according to the 2010 ADA Survey of Dental Practice.<sup>31</sup>

Of the 204 lesions that were yellow/light brown and treated invasively, 93 (46%) had no caries, inactive caries, or caries limited to the enamel, and 111 (54%) had caries into dentin. This is in contrast with the 274 dark brown/black lesions that were treated invasively, of which 111 (32%) had no caries, inactive caries, or caries limited to the enamel, and 88 (68%) had caries into dentin. This is in line with the findings of researchers in another study in which there was a correlation between color and lesion depth, in which darker lesions were more likely to have caries penetrating the dentin compared with the lighter

lesions.<sup>10</sup> However, dark brown/black color apparently did not, by itself, influence practitioners' decisions to open a lesion, given that the prevalence of dark brown/black lesions was identical in both overall and opened lesions (47%).

There was a statistically significant association between surface roughness and lesion depth ( $P = .01$ ). As the severity of the opened lesion depth increased, the percentage of the responses saying "yes" to surface roughness also increased. The "yes" responses gradually increased from 12 (3%) in the "no caries" category to 307 (64%) in the "dentin" category. Roughness apparently did influence decisions to open lesions, given that the prevalence of roughness was higher for opened lesions ( $n = 477$ , 82%) than for the overall sample ( $n = 1,096$ , 69%). Similarly, chalky lesions were significantly associated with caries into the dentin and apparently influenced practitioners' decisions, with a greater prevalence of chalky lesions in the opened lesion group ( $n = 258$ , 66%) than in the overall sample ( $n = 852$ , 53%). Although there was not a statistically significant association between lesion depth and patient risk, people at elevated risk had a high percentage of their lesions into dentin ( $n = 204$ , 67%), with small percentages of their SOCLs with no caries ( $n = 8$ , 3%), inactive caries ( $n = 16$ , 5%), or into the enamel only ( $n = 77$ , 25%). These findings are consistent with other studies in which researchers have reported that patients in elevated-risk categories are at greater risk of developing future caries, and this is an important factor to consider when developing a treatment plan.<sup>32,33</sup> Our results suggest that patient risk influenced decisions to open lesions, as elevated-risk prevalence was higher among opened lesions (52%;  $n = 305$ ) than in the overall sample (35%;  $n = 554$ ).

## CONCLUSIONS

Despite the statistically significant associations between the clinical characteristics that we examined and the presence of caries extending into dentin and despite the apparent use of these characteristics by the participating practitioners, these characteristics do not seem to be strong independent predictors of dentinal caries in clinical practice. In response to the question "When you treated the lesion, what did you find?", practitioners reported active caries extending into the dentin in 359 of 585 lesions (61%) that received surgical treatment. Thus, we found an overall false-positive (defined as a lesion that is either not into dentin or is inactive) rate of 39% for intervening owing to dentinal caries. In addition, due to the design of our study, we cannot speak to the presence or absence of caries into dentin for the lesions that were unopened. Given the equivocal nature of the relationship between lesion characteristics and dentin penetration, practitioners should exercise caution before selecting surgical treatment. Until more accurate means

of detecting caries penetration into dentin become available, this study, along with recent literature that points to noninvasive management of early carious lesions,<sup>34</sup> strengthen the recommendation that conservative management is the more appropriate course for SOCLs. ■

## SUPPLEMENTAL DATA

Supplemental data related to this article can be found at <http://dx.doi.org/10.1016/j.adaj.2017.08.009>.

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