Published in final edited form as:

J Am Dent Assoc. 2014 November ; 145(11): 1112–1118. doi:10.14219/jada.2014.82.

Twenty-month follow-up of occlusal carious lesions deemed questionable at baseline:

Findings from The National Dental Practice-Based Research Network

Dr. Sonia K. Makhija, DDS, MPH,

Associate professor, Department of Clinical and Community Sciences, School of Dentistry, University of Alabama at Birmingham, Diagnostic Sciences, 1919 7th Ave South, SDB 115, Birmingham, Ala. 35294-0007

Dr. Gregg H. Gilbert, DDS, MBA,

Professor and Chair, Department of Clinical and Community Sciences, School of Dentistry, University of Alabama at Birmingham

Dr. Ellen Funkhouser, DrPH,

Associate professor, Division of Preventive Medicine, Department of Medicine, University of Alabama at Birmingham

Dr. James D Bader, DDS, MPH,

Research professor, Department of Operative Dentistry, University of North Carolina at Chapel Hill

Dr. Valeria V. Gordan, DDS, MS, MS-CI,

Professor, Department of Restorative Dental Sciences, Division of Operative Dentistry, College of Dentistry, University of Florida Health Science Center, Gainesville

Dr. D. Brad Rindal, DDS,

A practitioner in the HealthPartners Dental Group, Minneapolis, and an investigator at the HealthPartners Institute for Education and Research, Minneapolis

Dr. Vibeke Qvist, DDS, PhD, DrOdont, and

An associate professor, Department of Cariology and Endodontics, School of Dentistry, University of Copenhagen, Denmark

Ms. Pia Nørrisgaard

Research Assistant, Department of Cariology and Endodontics, School of Dentistry, University of Copenhagen, Denmark

For The National Dental PBRN Collaborative Group

Abstract

Address correspondence to Dr. Makhija. smakhija@uab.edu.

Disclosure. None of the authors reported any disclosures.

Background—A questionable occlusal caries (QOC) lesion can be defined as an occlusal surface with no radiographic evidence of caries, but caries is suspected because of clinical appearance. In this study, the authors report the results of a 20-month follow-up of these lesions.

Methods—Fifty-three clinicians from The National Dental Practice-Based Research Network participated in this study, recording lesion characteristics at baseline and lesion status at 20 months.

Results—At baseline, 1,341 QOC lesions were examined; the treatment that was planned for 1,033 of those at baseline was monitoring (oral hygiene instruction, applying or prescribing fluoride or varnish, or both), and the remaining 308 received a sealant ($n = 192$) or invasive therapy ($n = 116$). Of the 1,033 monitored lesions, the clinician continued at the 20-month visit to monitor 927 (90 percent). Clinicians decided to seal 61 (6 percent) of these lesions (mean follow-up, 19 months), and invasively treat 45 (4 percent) of them (mean follow-up, 15 months). Young patient age (< 18 years) (odds ratio = 3.4; 95 percent confidence interval, 1.7–6.8) and the lesion's being on a molar (odds ratio = 1.8; 95 percent confidence interval, 1.3–2.6) were associated with the clinician's deciding at some point after follow-up to seal the lesion or treat it invasively.

Conclusions—Almost all (90 percent) QOC lesions for which the treatment planned at baseline was monitoring still were planned to undergo monitoring after 20 months. This finding suggests that noninvasive management is appropriate for these lesions.

Practical Implications—Previous study results from baseline indicated a high prevalence for QOC lesions (34 percent). Clinicians should consider long-term monitoring when making treatment decisions about these lesions.

Keywords

Evidence-based dentistry; private practice; caries; practice-based research; questionable lesions; multicenter studies; clinical research; dental caries; longitudinal study

Although the prevalence of dental caries in many populations across the world has decreased substantially,¹ dental caries remains a prominent health problem² that is experienced by more than 90 percent of all dentate adults and more than two-thirds of children in the United States, with a wide range of severity.^{3,4} Caries prevalence has decreased to a fraction of the levels seen in the past⁵ partly because of the introduction of fluoride.⁶ However, the use of fluoride has led to difficulty in detecting occlusal caries lesions because it can result in an intact surface that has subsurface demineralization.^{7,8} This can lead to changes in the clinical appearance of these caries lesions.⁹

There are essentially two types of such lesions. In hidden caries, demineralization has progressed to the point at which it is detectable radiographically. In questionable occlusal caries (QOC) lesions, which are the focus of this study, the tooth has no cavitation and no radiographic evidence of caries, but the presence of a caries lesion is suspected owing to roughness, surface opacities or staining. Such lesions may be difficult to diagnose and treat correctly.^{9–12} Having more information about the characteristics of these lesions when they first are diagnosed, as well as whether these lesion characteristics change over time and

which kind of treatment ultimately becomes advisable, may be the first step toward improving our understanding about how best to diagnose and treat these lesions.

To date, there have been few studies regarding the characteristics, management and treatment of these lesions^{8,10–13} and only one in which the investigators examined their progression.¹⁴ As a result, there is no consensus about how best to manage them. An earlier analysis of initial data from this study indicates that among patients receiving care at dental practices in The National Dental Practice-Based Research Network (the “network”); the prevalence of QOC lesions was substantial and varied significantly across regions, with an overall patient prevalence of 34 percent.¹⁵ Our purpose in this study was to follow 1,341 QOC lesions identified in general and pediatric community practice settings, relating the characteristics of these lesions at baseline to their characteristics and treatment received during the subsequent 20-month follow-up.

METHODS

Study population

We conducted this study with patients visiting dental practices in the network. At the time of the data collection for the investigation, the network was one of three regional practice-based research networks established in 2005 with a seven-year grant from the National Institute of Dental and Craniofacial Research. The network included practitioners from the United States and Scandinavia. The following regions participated in this study: Alabama/Mississippi (AL/MS), Florida/Georgia (FL/GA), Minnesota (MN) and Denmark (DK). The network subsequently evolved into its current form,¹⁶ under the aegis of which we prepared the manuscript of this article. The respective institutional review board in each region approved the study. All participants in this investigation provided informed consent after receiving a full explanation of the nature of the procedures.

Selection and recruitment process

Selection and recruitment have been described previously,¹⁵ but we will provide a brief overview of the process here. To be eligible for this study, practitioners had to complete both the network’s enrollment questionnaire and a questionnaire regarding how they diagnose and treat dental caries (“Assessment of Caries Diagnosis and Caries Treatment” questionnaire, available at <http://nationaldentalpbrn.org/study-results.php>), attend an orientation session or watch a video of it, and complete their training in 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.

Study design

The study design also has been described previously,¹⁷ but essentially, 82 practitioners collected data in their offices. If a patient had a QOC lesion, met the requirement of having a radiograph no older than six months and consented to participate in the study, the practitioner completed a data collection form. Up to two lesions could be enrolled per patient. The data collection form included information specific to the patient and lesion.

Practices were asked to enroll approximately 25 lesions. Practitioners saw patients approximately 20 months later (referred to as a “scheduled” visit to coincide with their regular treatment) and completed a data collection form with information gathered about the enrolled lesion. If planned treatment was changed from monitoring at baseline to either sealant placement or invasive therapy (enameloplasty, preventive resin restoration or full restoration) at an interim visit (that is, a visit between the baseline visit and the scheduled 20-month visit), the practitioner completed a change-of-treatment form. Example data collection forms are available at <http://nationaldentalpbrn.org/study-results.php>.

Statistical methods

We determined whether or not an interim visit occurred; whether or not the reason for the visit, be it interim or scheduled follow-up, was because of the QOC lesion; and whether or not the forms were completed by the same practitioner (for the baseline visit and either an interim visit or scheduled follow-up visit). We calculated time from baseline visit to scheduled follow-up visit and to interim visit, if applicable.. We ascertained the distributions of patient, tooth, lesion and visit characteristics overall, and among lesions for which the treatment planned at baseline for was monitoring (oral hygiene instruction and/or applying or prescribing fluoride or varnish), according to type of treatment recommended at follow-up visit, either interim or scheduled follow-up. If planned treatment was changed from monitoring at baseline to either sealant placement or invasive therapy at an interim visit and not changed again at the scheduled follow-up visit, then we assigned the treatment plan at follow-up as the treatment planned during the interim visit, and we assigned the length of follow-up (in months) as the number of months between the baseline and interim visits.

Among the lesions for which the treatment planned at baseline was monitoring, we examined whether there was an association between whether the lesion was still recommended for monitoring at the follow-up visit (interim or scheduled), as compared with the lesion’s baseline characteristics. We built a predictive model with the outcome being that the treatment planned at follow-up was either sealant placement or invasive therapy (primarily, restoration). Then we constructed separate models for the outcomes of “sealed” and “restored.” For models for which the outcome was “sealed,” we excluded lesions that were restored or planned to be restored, for models for which outcome was invasive therapy (“restored”), we excluded lesions that were sealed or were planned to be sealed excluded. Full models included the baseline recording of whether or not the practice was in Denmark, whether the lesion was on a molar (rather than a premolar), whether the patient usually returned to the practice for recall visits, whether the patient was younger than 18 years of age, and the lesion’s color and luster, all of which were determined at the baseline visit.

We built reduced models, starting from the full model and using a backwards variable selection procedure, retaining variables with $P < .10$. We used a 10 percent significance level for variable retention because of the small numbers involved in the outcome. P-values between five and ten percent are referred to as being of marginal statistical significance. We did not include the following visit characteristics in the model because small cell sizes resulted in unstable estimates and model instability: being seen by the same practitioner, the QOC lesion’s being the reason for the visit, and having an interim visit.. We calculated odds

ratios (ORs) and 95 percent confidence intervals (CIs) from the equations. We ascertained the significance of differences, adjusted for clustering within practitioner, by using generalized linear models. Fisher's exact test was used to assess significance of differences in proportions. We conducted all analyses by using software (SAS Version 9.3, SAS Institute, Cary, N.C.).

RESULTS

Overall, 53 (of 82) practitioners¹⁷ provided follow-up data for 893 (65 percent) of their 1,366 patients. Completion was better among older, non-Hispanic white patients, those with some dental insurance, and those who usually made regular recall visits, and those whose baseline treatment was either monitoring (65 percent [1,033/1,584]) or sealant placement (81 percent [192/236]) compared with those treated with an invasive procedure (51 percent [116/227]). Follow-up also differed according to region: the highest rate was in Denmark (78 percent [736/938]), which was similar to the rate for the AL/MS region (68 percent [270/395]) and the MN region (71 percent [82/116]). The FL/GA region had a lower follow-up rate (42 percent [25/598]). We report here on 1,341 lesions, 893 patients and 53 practitioners followed for a mean (standard deviation) of 20 (3.1) months (range, 12–34 months).

Practitioners

Of the 53 practitioners, the majority were non-Hispanic white (89 percent; 47/53) and in general practice (77 percent; 41/53). Overall, 30 (57 percent) were male, and almost one-half were from Denmark (45 percent; 24/53). Twelve (23 percent) were from pediatric practices.^{15–17}

Patients

The mean (standard deviation [SD]) age of the 893 patients was 34 (18) years (age range, 5–85 years); 26 percent (236/893) were 18 years or younger at baseline. A preponderance had at least some dental insurance (92 percent; 820/893), usually made regular recall visits (92 percent; 824/893), and were non-Hispanic white (84 percent; 648/773 self-report); 48 percent (426/892, missing 1) were male, and 55 percent (466/893) were from Denmark.

Lesions

Of the 1,341 lesions, 67 percent (n = 895) were on molars. At baseline, 18 percent (n = 236) were light (opaque or white) in color and 48 percent (n = 645) had a shiny luster. A preponderance, 88 percent (n = 1178 of 1335; data missing for 6), were seen by the same practitioner at follow-up as at baseline; only 4 percent (n = 56) were seen at an interim visit that had to do with this lesion; and 1 percent (n = 11) were seen at a visit the patient made primarily for the enrolled lesion at follow-up.

Treatment

QOC lesions that received invasive therapy at baseline—Of the 116 lesions that were treated with an invasive procedure at baseline, 98 (84 percent) were acceptable at follow-up, five (4 percent) were not acceptable and no additional treatment information was

available for 13 (11 percent) (Table 1). When we examined them according to type of invasive therapy at baseline, high acceptability was present for an enameloplasty and full restorations, at 84 percent and 88 percent, respectively, but not for preventive resin restoration, which had an acceptability of 56 percent, although this difference was not statistically significant ($P = .15$). Of lesions treated invasively, only three were seen at an interim visit, one had been treated with enameloplasty and two had been fully restored.

QOC lesions that received a sealant at baseline—Of the 192 lesions that were sealed at baseline (Table 1), 170 (88 percent) were acceptable and 16 (8 percent) were not acceptable; there was no information about six (3 percent). Of the 16 that were not acceptable, the majority—13 (81 percent)—were repaired, one was treated with an enameloplasty and two were restored. Of the lesions sealed at baseline, four were seen at an interim visit, two sealants were repaired, one was treated with an enameloplasty and one was restored.

QOC lesions monitored at baseline—Of the 1,033 lesions for which the treatment planned at baseline was monitoring, 90 percent ($n = 927$) also had monitoring as the treatment planned at the follow-up visit, 6 percent ($n = 61$) were sealed and 4 percent ($n = 45$) received invasive treatment during follow-up (Table 1).

Table 2 shows the follow-up times of the lesions for which the treatment planned at baseline was monitoring, according to whether or not they received treatment during follow-up or were seen in an interim visit. Five percent ($n = 49$) of the lesions for which the treatment planned at baseline was monitoring were seen in an interim visit. These composed less than one percent ($n = 4$) of the 927 lesions that received no additional treatment recommendations; in other words, the treatment plan after follow-up remained monitoring. In contrast, lesions that were seen at interim visits comprised 23 percent ($n = 14$) of the 61 lesions that were sealed during follow-up or that were planned to be sealed at follow-up and 69 percent ($n = 31$) of the 45 lesions that were treated invasively (primarily restored) during follow-up or that were planned to be restored at follow-up. For lesions that were sealed during follow-up or for which the treatment planned was sealant placement, there was no difference in follow-up times between those with and those without an interim visit; both were 19 months. In contrast, for lesions restored during follow-up or for which the treatment planned was restoration placement at follow-up, those with an interim visit had a shorter follow-up time (15 months versus 20 months; $P < .01$).

In assessing whether differences existed across treatment that was received during or planned at follow-up, adjusting only for clustering, we found that tooth type (on a molar; $P = .006$) and being seen at an interim visit ($P = .001$) were the only characteristics that differed significantly across follow-up treatment groups (Table 3). In general, there was little difference in the magnitude or statistical significance of associations with not being monitored at follow-up—namely, being sealed or restored—in both the full and the reduced predictive models (Table 4). From the reduced predictive model for not being monitored at follow-up, young age (< 18 years; OR = 3.4; 95 percent CI, 1.7–6.8) and lesion's being on a molar (OR = 1.8; 95 percent CI, 1.3–2.6) were associated with some type of invasive therapy at follow-up (Table 4).

Of the 112 lesions not monitored at follow-up, 65 were sealed and 47 were restored. When assessed separately for type of treatment at follow-up, there were modest differences. For lesions that were sealed, young age and the lesion's being on a molar remained associated, and light color (OR = 0.4; 95 percent CI, 0.2–1.0; $P = .08$) was associated inversely and was of marginal statistical significance. For lesions that were restored, young age no longer was significantly associated, the lesion's being on a molar was associated, light color was associated directly (OR = 2.2; 95 percent CI, 1.2–3.9; $P = .08$) and the practitioner's being from the Denmark region was inversely associated (OR = 0.5; 95 percent CI, 0.2–1.0; $P = .08$), though the latter two were only of marginal statistical significance.

DISCUSSION

There has been debate about the correlation between clinical characteristics of QOC lesions and whether or not they progress to caries, necessitating invasive therapy. Some studies have shown that the detection of brown or black fissures is not a useful indication of lesion progression. In a study by Francescut and Lussi,¹⁸ after being subjected to histologic sectioning, 57 percent of teeth with dark brown to black discolored fissures showed either no caries or caries limited to the outer one-half of enamel. Steiner and colleagues,¹⁹ on the other hand, suggested that brown- or black-stained fissures were more likely to indicate carious lesions. The results of Francescut and colleagues' study showed that once subjected to histologic examination, 42 percent of yellow to light brown lesions and 27 percent of opaque lesions had caries in the middle one-third of dentin¹⁸. Investigators in other studies have found that visual examination was a more accurate predictor of caries than were other methods, such as radiographic examination for lesions such as these.^{20,21} There are no clear guidelines for managing these lesions.¹⁹

Limited information is available from general dental practice in the United States about the stage in the development of caries lesions that is considered appropriate for surgical intervention. According to a survey of the teaching of cariology in North American dental schools,²² about two-thirds of the schools advocated surgical intervention when lesions have reached dentin, mainly at the level of the outer one-third of the dentin (level D1), with the aid of radiographs. The remaining one-third of the schools taught the operative treatment of enamel lesions, mainly lesions in the inner one-half of enamel (level E2). In Florida, where the clinicians are graduates from dental schools across the United States almost 60 percent treated enamel lesions operatively, including 11 percent of E1 lesions, and only about 40 percent waited until the caries lesions reached dentin (I.A. Mjör, BDS,MS,MSD,Dr.Odont, unpublished data, 2004).²³ Our results suggest that the majority of lesions will not progress in 20 months and that invasive treatment can be avoided. This is in line with the recommended practice in Scandinavia, where dental schools teach a conservative, nonoperative approach to occlusal caries lesions without cavitation and radiographic evidence.^{23,24}

This study has limitations. We investigated diagnosis and treatment as delivered in routine, real-world community practice and therefore made no attempt to standardize or calibrate that diagnosis or treatment. Each practitioner was trained specifically for this study so as to standardize the data collection process, but we made no effort to standardize diagnostic or

treatment methods for a QOC. Indeed, such standardization would not be desirable, because an objective of the study was to determine the distribution of the characteristics of these lesions given the diagnostic methods that the clinicians normally use in routine practice. Another limitation was the high attrition rate. This high rate was localized primarily to the FL/GA region (42 percent). The lower follow-up from FL/GA is explained at least partially by patient characteristics and baseline treatment as compared with those of other regions. The FL/GA region had fewer patients who were non-Hispanic white, had insurance, made regular recall visits, and received noninvasive therapy at baseline; however, they had a greater number of older patients (all $P < .01$). Because the study was designed to obtain at baseline a representative estimate of the prevalence of QOC lesions in community practice settings, all eligible patients were enrolled at baseline. One consequence of that design is that patients are enrolled who are projected to be at high risk of not returning for a follow-up visit. It is possible that conclusions about monitoring would have been different in this study if all of these patients had returned for follow-up.

Dental care has evolved slowly from the approach of restoring all carious lesions, regardless of size, to one of “early detection and management.”¹⁶ Hamilton and colleagues¹⁴ studied 223 QOC lesions in a randomized trial comparing air abrasion with monitoring over a two-year observation period. Only 16 percent ($n = 100$) of the lesions randomly assigned to the monitoring arm progressed into the dentin by the end of the two-year observation period on the basis of clinical examination, showing that conservation of tooth structure is possible. Results from our study were similar to those from the Hamilton¹⁴ study in that after 20 months, 90 percent of the lesions monitored at baseline still were recommended for monitoring at follow-up. The remaining 10 percent were either sealed (6 percent) or treated invasively (4 percent) at some point after baseline. Our earlier results indicated that almost one-half of lesions that were opened at baseline either had no caries, inactive caries or caries limited to the enamel; therefore, in hindsight, the practitioner realized that invasive therapy was not actually warranted.¹⁷ These results indicate that treating a QOC lesion noninvasively may be appropriate.

CONCLUSIONS

These results indicate that treating a QOC non-invasively may be an appropriate treatment decision. By recording information over a 20-month period on the clinical characteristics of the lesion and patient, the associations inferred will ultimately provide information to clinicians regarding which characteristics offer more valid information about the caries status of questionable lesions, and whether or not these lesions are best monitored for progression or instead treated invasively.

Acknowledgments

The research described in this article was supported by grants U01-DE-16746, U01-DE-16747 and U19-DE-22516 from the National Institute of Dental and Craniofacial Research, National Institutes of Health, Bethesda, Md.

Opinions and assertions contained herein are those of the authors and are not to be construed as necessarily representing the views of the respective organizations or the National Institutes of Health. All participants in this investigation provided written or verbal informed consent after receiving a full explanation of the nature of the procedures had been explained fully.

The National Dental Practice-Based Research Network Collaborative Group comprises practitioners, faculty and staff investigators who contributed to this network activity. A list of these people is available at <http://www.nationaldentalpbrn.org/collaborative-group.php>.

ABBREVIATION KEY

AL/MS	Alabama/Mississippi
FL/GA	Florida/Georgia
MN	Minnesota
QOC	Questionable occlusal <u>caries</u>

References

1. Pretty IA, Ellwood RP. The caries continuum: opportunities to detect, treat and monitor the remineralization of early caries lesions. *J Dent*. 2013; 41(suppl 2):S12–S21. [PubMed: 23985434]
2. MMWR Surveillance Summaries. Aug 26; 2005 54(03):1–44.
3. Kaste LM, Selwitz RH, Oldakowski RJ, Brunelle JA, Winn DM, Brown LJ. Coronal caries in the primary and permanent dentition of children and adolescents 1–17 years of age: United States, 1988–1991. *J Dent Res*. 1996; 75(special number):631–641. [PubMed: 8594087]
4. Winn DM, Brunelle JA, Selwitz RH, et al. Coronal and root caries in the dentition of adults in the United States, 1988–1991. *J Dent Res*. 1996; 75(special number):642–651. [PubMed: 8594088]
5. Whelton H. Overview of the impact of changing global patterns of dental caries experience on caries clinical trials. *J Dent Res*. 2004; 83(special number C):C29–C34. [PubMed: 15286118]
6. Brathall D, Hänsel-Petersson G, Sundberg H. Reasons for the caries decline: what do the experts believe? *Eur J Oral Sci*. 1996; 104(4 pt 2):416–422. [PubMed: 8930592]
7. Lussi A. Comparison of different methods for the diagnosis of fissure caries without cavitation. *Caries Res*. 1993; 27(5):409–416. [PubMed: 8242679]
8. Hamilton JC, Dennison JB, Stoffers KW, Welch KB. A clinical evaluation of air-abrasion treatment of questionable carious lesions: a 12-month report. *JADA*. 2001; 132(6):762–769. [PubMed: 11433855]
9. Pine CM, ten Bosch JJ. Dynamics of and diagnostic methods for detecting small carious lesions. *Caries Res*. 1996; 30(6):381–388. [PubMed: 8946093]
10. Sawle RF, Andlaw RJ. Has occlusal caries become more difficult to diagnose? A study comparing clinically undetected lesions in molar teeth of 14–16-year old children in 1974 and 1982 (published correction appears in *Br Dent J* 1988;164 [11]:361). *Br Dent J*. 1988; 164(7):209–211. [PubMed: 3163930]
11. Ketley CE, Holt RD. Visual and radiographic diagnosis of occlusal caries in first permanent molars and in second primary molars. *Br Dent J*. 1993; 174(10):364–370. [PubMed: 8494666]
12. Ouellet A, Hondrum SO, Pietz DM. Detection of occlusal carious lesions. *Gen Dent*. 2002; 50(4):346–350. [PubMed: 12640851]
13. Meiers J, Jensen ME. Management of the questionable carious fissure: invasive vs noninvasive techniques. *JADA*. 1984; 108(1):64–68. [PubMed: 6582117]
14. Hamilton JC, Dennison JB, Stoffers KW, Gregory WA, Welch KB. Early treatment of incipient carious lesions: a two-year clinical evaluation. *JADA*. 2002; 133(12):1643–1651. [PubMed: 12512664]
15. Makhija SK, Gilbert GH, Funkhouser E, et al. National Dental Practice-Based Research Network Collaborative Group. The prevalence of questionable occlusal caries: findings from the Dental Practice-Based Research Network. *JADA*. 2012; 143(12):1343–1350. [PubMed: 23204090]
16. Gilbert GH, Williams OD, Korelitz JJ, et al. National Dental PBRN Collaborative Group. Purpose, structure, and function of the United States National Dental Practice-Based Research Network. *J Dent*. 2013; 41(11):1051–1059. [PubMed: 23597500]

17. Makhija SK, Gilbert GH, Funkhouser E, et al. National Dental PBRN Collaborative Group. Characteristics, detection methods, and treatment of questionable occlusal carious lesions: findings from the National Dental Practice-Based Research Network. *Caries Res.* 2014; 48(3):200–207. [PubMed: 24480989]
18. Francescut P, Lussi A. Correlation between fissure discoloration, Diagnodent measurements, and caries depth: an in vitro study. *Pediatr Dent.* 2003; 25(6):559–564. [PubMed: 14733470]
19. Steiner M, Helfenstein U, Menghini G. Association of salivary mutans streptococci with discoloured pits and fissures. *Community Dent Oral Epidemiol.* 1998; 26(6):412–417. [PubMed: 9870541]
20. Ekstrand KR, Ricketts DN, Kidd EA. Reproducibility and accuracy of three methods for assessment of demineralization depth of the occlusal surface: an in vitro examination. *Caries Res.* 1997; 31(3):224–231. [PubMed: 9165195]
21. Ekstrand KR, Kuzmina I, Bjørndal L, Thylstrup A. Relationship between external and histologic features of progressive stages of caries in the occlusal fossa. *Caries Res.* 1995; 29(4):243–250. [PubMed: 7656292]
22. Clark TD, Mjör IA. Current teaching of cariology in North American dental schools. *Oper Dent.* 2001; 26(4):412–418. [PubMed: 11504443]
23. Kidd, E.; Fejerskov, O. The control of dental caries: non-operative treatment. In: Fejerskov, O.; Kidd, E., editors. *Dental Caries: The Disease and Its Clinical Management*. 2. Hoboken, N.J: Wiley-Blackwell; 2008. p. 255-258.
24. Kidd, E.; van Amerongen, P.; van Amerongen, E. The role of operative treatment in caries control. In: Fejerskov, O.; Kidd, E., editors. *Dental Caries: The Disease and Its Clinical Management*. 2. Hoboken, N.J: Wiley-Blackwell; 2008. p. 445-458.

Table 1

Distribution of patients according to follow up visit treatment received or acceptability status.

BASELINE TREATMENT (n)	ACCEPTABILITY AT FIRST* FOLLOW-UP VISIT, n (%†)		
	Acceptable	Not Acceptable	No Information
Monitoring‡ (n = 1,033) §	927 (90)	Sealed: 61 (6) Treated Invasively 45 (4)	NA¶
Sealant Placement (n = 192)	170 (88)	16 (8)	6 (3)
Invasive Therapy# (n = 116)	98 (84)	5 (4)	13 (11)
Enameloplasty (n = 25)	21 (84)	1 (25)	3 (12)
Preventive resin restoration (n = 9)	5 (56)	2 (22)	2 (22)
Enameloplasty and preventive resin restoration (n = 2)	2 (100)	0 (0)	0 (0)
Restored (n = 80)	70 (88)	2 (2)	8 (10)

* First follow-up is interim visit (change of treatment), if applicable.

† Percentages do total 100 for each group because of rounding

‡ “Monitoring” is defined as oral hygiene instruction and/or applying or prescribing fluoride or varnish.

§ At follow-up, 927 (90 percent) were designated for continued monitoring, 61 (6 percent) were designated for sealing and 45 (4 percent) were designated for invasive therapy.

¶ NA: Not applicable.

Invasive therapy includes enameloplasty, preventive resin restoration or full restoration.

Table 2

Follow-up times, interim visits, and treatment received during follow-up or planned at follow-up visit in 1,033 lesions with baseline planned treatment of monitoring.

TREATMENT* PLANNED AT FOLLOW-UP VISIT OR RECEIVED DURING FOLLOW-UP	INTERIM VISIT	NO. OF LESIONS	MEAN (SD*) NO. OF MONTHS FROM BASELINE TO TREATMENT OR FOLLOW-UP VISIT
Monitoring [†]	All	927	20.4 (3.0)
	Yes	4	10.4 (3.8)
	No	923	20.5 (2.9)
Scaledant Placement	All	61	19.2 (4.2)
	Yes	14	19.0 (7.5)
	No	47	19.3 (2.5)
Invasive Therapy [‡]	All	45	16.8 (6.2)
	Yes	31	15.3 (6.7)
	No [§]	13	20.4 (2.2)

* SD: Standard deviation.

[†]“Monitoring” is defined as oral hygiene instruction and/or applying or prescribing fluoride or varnish.

[‡]Invasive includes enameloplasty, preventive resin restoration and full restoration.

[§]Missing follow-up date and time for one lesion.

Table 3

Characteristics of questionable occlusal caries (QOC) lesions for which treatment planned at baseline was monitoring, according treatment received during or planned at follow-up.

CHARACTERISTIC*	TREATMENT [†] RECEIVED DURING FOLLOW-UP OR PLANNED AT FOLLOW-UP, NO. (%) [‡]			P VALUE [§]
	Monitoring [§] (n = 927)	Sealant Placement (n = 61)	Invasive Therapy [¶] (n = 45)	
Patient Recorded at Baseline as Having Made Regular Recall Visits	861 (93)	52 (85)	42 (93)	.180
Patient Age at Baseline: < 18 years	95 (10)	32 (52)	8 (18)	.104
QOC Lesion				
On a molar	556 (60)	53 (87)	33 (73)	.006
Light color at baseline	110 (12)	8 (13)	11 (24)	.168
Shiny luster at baseline	456 (49)	37 (61)	20 (44)	.596
Practitioner from the Denmark Region	559 (60)	18 (30)	19 (42)	.396
Examining Practitioner Same At Baseline And Follow-Up Visit	810 (87)	56 (92)	41 (91)	.568
Reason for Follow-Up Visit Was the QOC Lesion	5 (0.5)	0 (0)	5 (11)	Not estimable
An Interim Visit Occurred	4 (0.4)	14 (23)	31 (69)	.001

* Missing: regular recall, four; same practitioner, three; visit for same lesion, one.

[†] Percentages within each indicated group according to treatment planned.

[‡] For significance of differences across categories of treatment adjusted for clustering within practitioner.

[§] "Monitoring" is defined as oral hygiene instruction, applying or prescribing fluoride or varnish, or both.

[¶] "Invasive therapy" is defined as enameloplasty, preventive resin restoration and full restoration.

Table 4

Adjusted* associations between the questionnaire occlusal caries (QOC) lesion characteristic and whether those for which the treatment planned at baseline was monitoring had sealant placement or restoration received during or planned at follow-up.

CHARACTERISTIC	ASSOCIATIONS WITH TREATMENT RECEIVED DURING FOLLOW-UP OR PLANNED AT FOLLOW-UP									
	Sealed or Restored					Restored				
	OR [†]	95% CI [‡]	P value	OR	95% CI	P value	OR	95% CI	P value	
Full Model										
Regular recall visits	0.8	0.4–2.0	.695	0.6	0.2–1.4	.303	1.4	0.4–5.4	.557	
Age <18 years	3.6	1.7–7.4	.013	5.1	2.2–11.4	.012	1.1	0.3–3.6	.897	
QOC lesion										
On a molar	2.1	1.4–3.1	.001	2.1	1.2–3.6	.012	1.9	1.0–3.5	.044	
Light color at baseline	0.9	0.5–1.7	.818	0.4	0.2–1.1	.097	2.6	1.2–5.5	.016	
Shiny luster at baseline	1.2	0.7–2.1	.492	1.0	0.6–1.8	.921	1.6	0.7–3.4	.286	
Practitioner from the Denmark region	0.5	0.2–1.2	.182	0.5	0.2–1.8	.355	0.5	0.2–1.2	.179	
Reduced Model										
Regular recall visits [§]										
Age <18 years	3.4	1.7–6.8	.015	4.9	2.2–10.9	.014				
QOC lesion										
On a molar	1.8	1.3–2.6	.003	1.8	1.2–2.8	.020	1.8	1.0–3.4	.044	
Light color at baseline				0.4	0.2–1.0	.076	2.2	1.2–3.9	.075	
Shiny luster at baseline										
Denmark region							0.5	0.2–1.0	.076	

* Adjusted for characteristics listed.

[†] OR: Odds ratio.

[‡] CI: Confidence interval.

[§] Patient recorded at baseline as having made regular recall visits.