Definition of At-Risk Occlusal Surfaces of Permanent Molars—A Descriptive Study

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*The **objective** of this descriptive study was to define the at-risk occlusal surface to guide the practitioner in the decision of whether to seal or not. Method: All dentists affiliated with the French Society of Pediatric Odontology (SFOP) and general practitioners (GP) registered in postgraduate courses in three French dental schools answered the same questionnaire illustrating four occlusal surfaces of permanent molars. It was focused on obtaining an optimal definition of an at-risk occlusal surface. The corresponding four molars were later sectioned to check the answers. Univariate logistic regression analyses and multivariate logistic regression models were tested to identify the factors associated with the at-risk occlusal surface. **Results:** Eighty-six SFOP dentists and 136 GP filled in the form. Multivariate logistic regression models stratified by type of practice demonstrated that stained fissures (p=0.001) were only associated with at-risk occlusal surface among GP and the morphology of primary fissure (p=0.001) when considering SFOP dentists alone. The multivariate analyses demonstrated that stained fissures, and primary and secondary fissures were linked to the perception of an at-risk occlusal surface. **Conclusion:** An at-risk occlusal surface has narrow and deep primary fissures. Numerous secondary fissures could increase the risk. The coloration of fissures should not be used in the definition because it depends on tooth integrity.*

Keywords: *pit fissure, sealant, risk, occlusal caries*
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INTRODUCTION

National policies, guidelines, and more particularly recommendations resulting from evidence-based dentistry methodology, advocate pit and fissure sealants for people with high individual caries risk (ICR).[1–5] However, in the case of at-risk teeth, the indication of sealants is systematic and no longer depends on the ICR.[4,6–14] Moreover sealant benefit is increased by placement on surfaces that already exhibit incipient carious lesions.[4,6] Therefore, some molars may benefit from sealant application independently of ICR because of fissure anatomy. Now, a precise definition of the at-risk occlusal surface to be sealed systematically does not exist. Only different descriptions are sometimes found such as: “deep pit and fissures”, “deeply-fissured surface,” “stained areas,” “deep and narrow fissures,” “deep and sticky fissures.” Classifications for pit and fissure anatomy exist only in *in vitro* studies.[15-17] In 1996, Symons *et al* proposed a visual classification (shallow, intermediate and deep), but after sectioning teeth, some fissure patterns were incorrectly classified through visual means.[18] In order to help both dentists and hygienists, a descriptive epidemiological study was carried out. The objective was to define the at-risk pit and fissure to guide the practitioner in decision making, to seal the occlusal surface of permanent molars regardless of ICR.

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MATERIAL AND METHOD

In France, contrary to what occurs in other European countries such as Sweden, Finland, Italy, Lithuania, Poland, Slovakia or Slovenia, pediatric dentistry is not a recognized speciality. This specific dental training is included in the initial formation of the future dentists. In dental offices, only a few French dentists treat mainly children; they are usually affiliated to the French Society of Paediatric Dentistry (SFOP). Other dentists are termed general practitioners (GP).

The study population included all dentists registered with SFOP (109) and 144 GP registered in postgraduate courses. during the first three months of the year. Our objective was to include in this study those dentists who assess the at-risk occlusal surface for pit and fissure sealing.

Assessment—A questionnaire was prepared by the

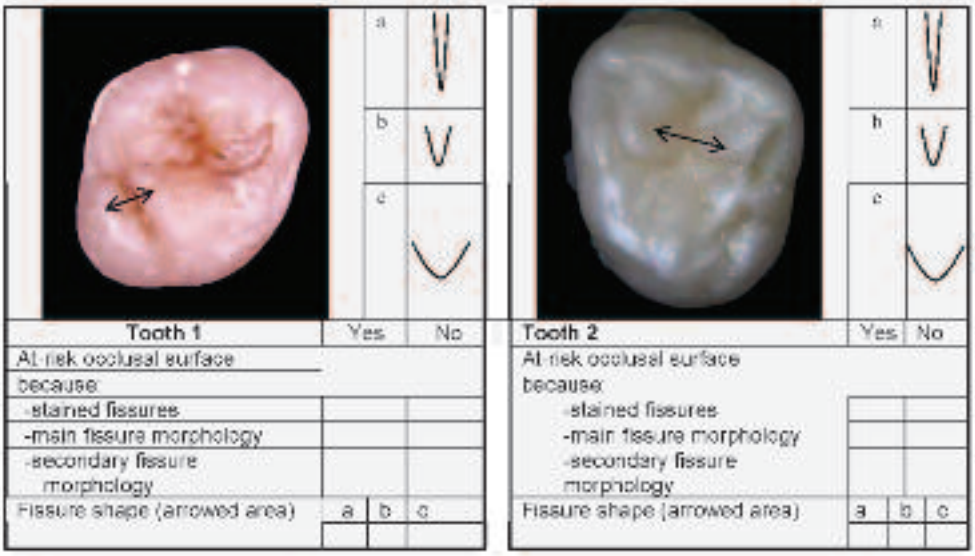
authors to assess the visual appearance of the at-risk occlusal surface of permanent molars. This form included four pictures of the occlusal surface of caries-free molars extracted for orthodontic reasons (Figure 1), and dentists were asked to identify the at-risk surfaces. Closed and open questions were asked to determine an optimal definition of the occlusal morphology. Dentists had to choose between three types of fissure shape to define the fissure morphology in the area indicated by an arrow: Type a (types Y1 and Y2), b (type V) or c (type U). So the type "a" is considered a deep fissure while type "c" a shallow fissure,[17] Lastly, dentists had to propose synonyms to describe at-risk occlusal surfaces.

Figure 1: Questionnaire

Fissure anatomy and pit and fissure sealants

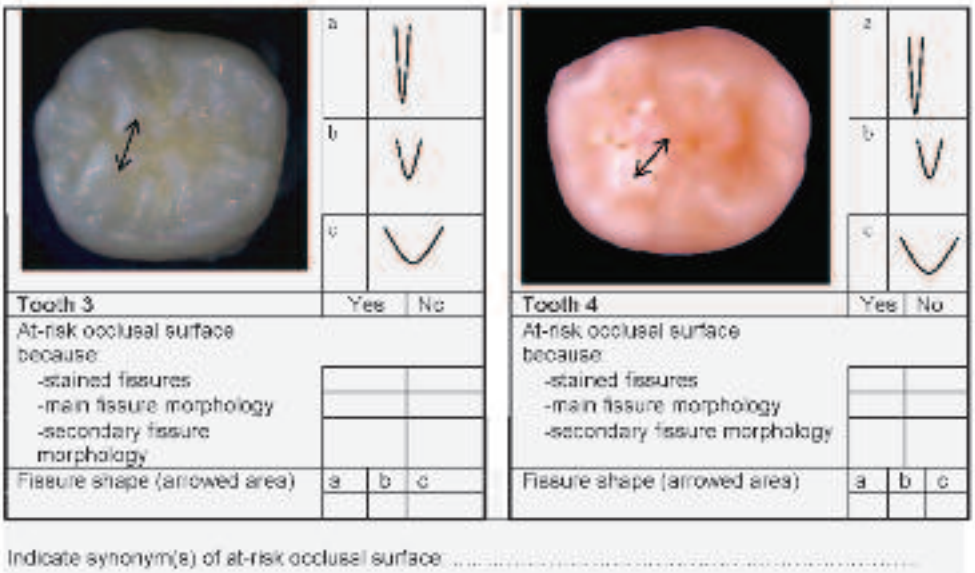
Initial dental school: ..... Date of diploma: .....
Sex: .....
General practitioner (GP) ☐ paediatric dentistry corresponds to main practice ☐
Member of French Society of Paediatric Dentistry (SFOP) ☐ Not a member ☐

If you define these occlusal surfaces as at-risk surfaces, indicate in the corresponding cases factors that may contribute to the definition. Indicate the fissure anatomy (a, b or c) in arrowed area



Tooth 1	Yes	No
At-risk occlusal surface because		
-stained fissures		
-main fissure morphology		
-secondary fissure morphology		
Fissure shape (arrowed area) a b c		

Tooth 2	Yes	No
At-risk occlusal surface because		
-stained fissures		
-main fissure morphology		
-secondary fissure morphology		
Fissure shape (arrowed area) a b c		



Tooth 3	Yes	No
At-risk occlusal surface because		
-stained fissures		
-main fissure morphology		
-secondary fissure morphology		
Fissure shape (arrowed area) a b c		

Tooth 4	Yes	No
At-risk occlusal surface because		
-stained fissures		
-main fissure morphology		
-secondary fissure morphology		
Fissure shape (arrowed area) a b c		

Indicate synonym(s) of at-risk occlusal surface .....

Figure 1. Questionnaire

Table 1. Univariate analyses assessing the factors associated with the visual qualification of the occlusal surfaces

	At-risk occlusal surface				OR	IC[95%]	p
	No		Yes				
	n	%	n	%			
Tooth							
N°1	11	5.0	211	95.0	1		
N°2	149	67.1	73	32.9	0.03	[0.01; 0.05]	0.001
N°3	159	71.6	63	28.4	0.02	[0.01; 0.04]	0.001
N°4	13	5.9	209	94.1	0.84	[0.37; 1.91]	0.675
Sex							
Female	170	35.7	306	64.3	1		
Male	162	39.3	250	60.7	0.86	[0.65; 1.13]	0.268
Dentist group							
SFOP	115	33.4	229	66.6	1		
GP	217	39.9	327	60.1	0.76	[0.57; 1.00]	0.053

This questionnaire was sent by email to all dentists registered with SFOP (SFOP dentists) and to GP registered in post graduate courses in Nancy, Nice and Paris Descartes dental schools.

Afterwards, and in order to check the answers, the four teeth were sectioned to observe the exact fissure morphology. They were first embedded in a self-curing acrylic resin (Plexil-Escil, Chassieu, France), and sectioned with a water-cooled diamond disc mounted at low-speed (Isomet™ – Buehler, Evanston, Illinois, USA) perpendicular to the arrowed area. Then they were examined under a stereomicroscope (Olympus SZH10, Tokyo, Japan) at a magnification of x 40.

Statistical analysis—A descriptive analysis was performed. Chi-square test (Pearson or Yates) allowed an analysis of the administrative qualitative variable distribution according to the group of dentists (SFOP or GP). In the case of quantitative variables, the t-test was used to compare the means (and standard deviation) in the different practice groups. Univariate and multivariate logistic regression analyses were conducted to identify the factors associated with the visual definition of at-risk occlusal surfaces. We performed these analyses considering firstly all teeth and then including tooth number (1 to 4) and administrative variables (e.g. sex, dentist group) or morphological variables (e.g. stained fissures, primary and secondary fissure morphology). Secondly, analyses were performed by tooth because the questionnaire included four pictures of teeth with different characteristics. In addition, stratified analyses were performed, to assess if the visual definition of an at-risk occlusal surface could be modified by the type of dental practice. Logistic results were presented using the odds ratio (OR) and 95% confidence intervals (IC[95%]). Kappa was used to assess the concordance of the described occlusal morphology of each tooth between 30 dentists selected at random from all dentist samples (15 dentists *per* group), four months after the first assessment. All these analyses were achieved with SPSS 14.5 by setting a significance level at 5%.

RESULTS

Eighty-six (78.9%) SFOP dentists and 136 GP (94.4%) accepted to participate in this study and filled in the questionnaire. Sixty-nine of the SFOP dentists treated only children. Females were more numerous among SFOP dentists than in the GP group: 66.3% (n=57) versus 45.6% (n=62) (p=0.003). Qualification year did not statistically differ according to the dentist groups: 1988 ± 10.7 versus 1990 ± 10.3 for SFOP dentists and GP respectively (p=0.172).

Considering the four pictures, 10 SFOP dentists (11.6%) and 12 GP (8.8%) assessed all teeth as being at-risk (p=0.496) and only three GP (2.2%) considered all teeth as not being at-risk (p=0.285). In the following analyses, we investigated which factors were associated with the at-risk occlusal surface when relying on a visual inspection of the four pictures. In the univariate logistic regression analyses, dentist group was almost statistically associated with the visual definition of an at-risk surface (p=0.053) (Table 1). In the multivariate logistic regression model, including tooth number and dentist group, the type of practice was related to the visual classification of occlusal surfaces considered as at-risk. SFOP dentists more frequently qualified the occlusal surface as at-risk than GP (OR=1.64 95% CI: 1.13; 2.38, p=0.01).

Considering only tooth 1, our results showed that most of the dentists, 98.9% among SFOP dentists (n=85) and 92.6% (n=126) GP, considered its occlusal surface as at-risk (Figure 2) (p=0.04). Thus most of the dentists (95%) identified its occlusal surface as at-risk because of the stained fissures (75.7% i.e. n=168 dentists) or because of the visual aspect of the primary (84.2%, n=187) or secondary grooves (51.8%, n=115). The visual aspect of the primary grooves to classify an occlusal surface as at-risk, was used frequently by all the dentist groups, even if its role to define an at-risk surface statistically differed according to the dental practice: 97.6% of the SFOP dentists (n=83) versus 82.5% of the GP (n=104) (p=0.001). The use of the visual aspect of the primary grooves to identify an occlusal surface as at-risk was in agreement with the observation of the sectioned tooth in the arrowed area. Figure 2 shows that the fissure was so deep that it reached the enamel-dentin junction.

On the contrary, most of the dentists did not define tooth 2 (67.1%, n=149) or tooth 3 (71.6%, n=159) as at-risk, based on their visual aspect (Figures 3, 4). SFOP dentists classified

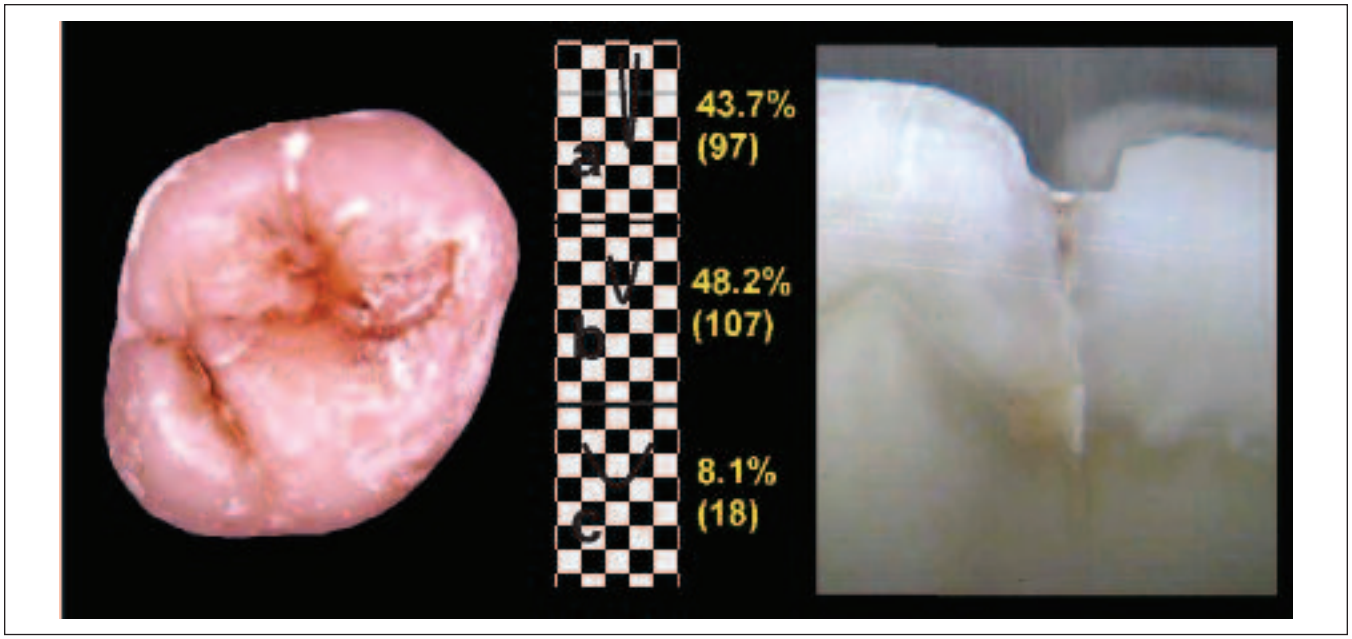


Figure 2. Tooth 1—Evaluation of the occlusal morphology in the arrowed area by 222 dentists and corresponding section of the tooth. 31.1% (69) of the dentists described the arrowed area and 32.9% (73) the whole occlusal surface of tooth 2 as at-risk. This qualification was given either regarding stained fissures (3.6% i.e. 8 dentists) or primary (25.2% i.e. 56) or secondary fissure morphology (20.7% i.e. 46).

tooth 2 as at-risk more frequently (41.9%, n=36) in comparison to GP (27.2%, n=37) (p=0.024). Again tooth 3 was most often considered as at-risk among SFOP dentists (32.6%, n=28) in comparison to GP (25.7%, n=35), even if this difference was not statistically significant (p=0.272). These results are in agreement with the observation of the sectioned tooth 2 and 3: they showed a fissure opening type c, considered as not being at-risk.

Lastly, the occlusal surface of tooth 4 was classified as at-risk by 94.1% (209) of the dentists. Most of the dentists used the coloration of the fissures (73.4%, n=163) or the visual aspect of the primary (72.5%, n=161) or secondary grooves (49.1%, n=109) to classify the tooth 4 occlusal surface as at-risk. The arrowed area was identified as at-risk by most of the SFOP dentists (93%, n=80) and GP (94.9%, n=128) (p=0.572). These results were in agreement with the fissure opening type a of sectioned tooth 4 (Fig. 5).

In the following analyses, we evaluated which characteristics were used most frequently among dentists to classify a surface as at-risk. These analyses were performed by dentist

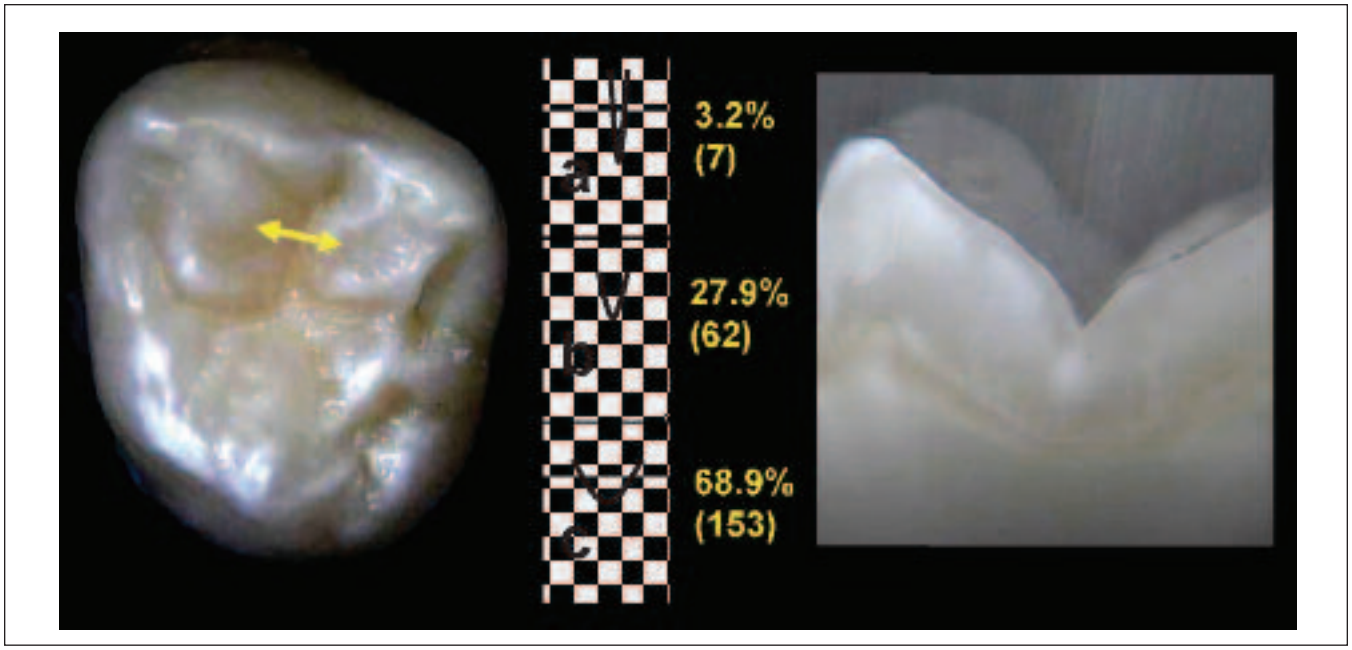


Figure 3. Tooth 2—Evaluation of the occlusal morphology in the arrowed area by 222 dentists and corresponding section of the tooth. 33.3% (74) of the dentists described arrowed area as at-risk and 28.4% (63) the whole occlusal surface of tooth 3 as at-risk. This qualification was given regarding stained fissures (3.2% i.e. 7 dentists), or primary (18% i.e. 40) or secondary fissure morphology (23% i.e. 51)

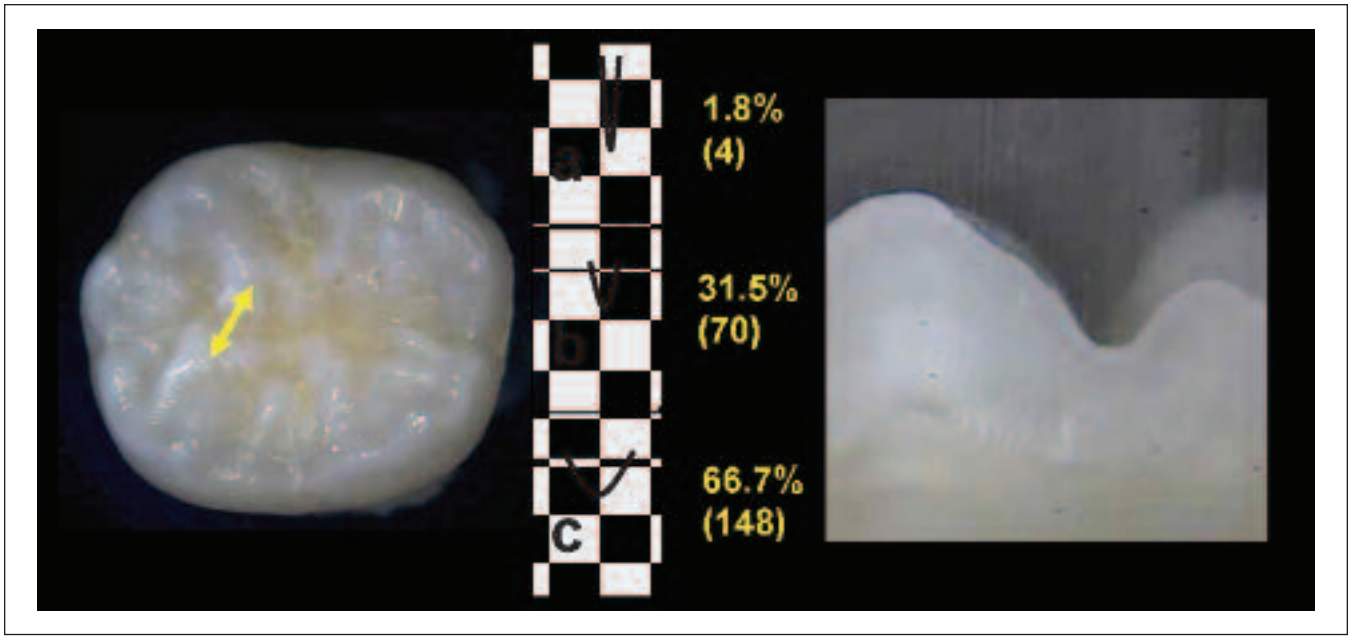


Figure 4. Tooth 3—Evaluation of the occlusal morphology in the arrowed area by 222 dentists and corresponding section of the tooth. 33.3% (74) of the dentists described arrowed area as at-risk and 28.4% (63) the whole occlusal surface of tooth 3 as at-risk. This qualification was given regarding stained fissures (3.2% i.e. 7 dentists), or primary (18% i.e. 40) or secondary fissure morphology (23% i.e. 51)

group and we included tooth number and morphological characteristics as independent variables. SFOP and GP dentists frequently used the visual aspect of the secondary fissure, i.e. its morphology, to classify an occlusal surface as at-risk (p=0.001 in both groups). The coloration of the fissures, i.e. the visual aspect of stained fissures, was most frequently used to classify an occlusal surface as at-risk by the GP (n=136) (p=0.001 vs p=0.983). SFOP dentists (n=86) most frequently used the visual aspect of the primary fissure, i.e. its morphology, for the classification of at-risk occlusal surfaces (p=0.001). In both stratified analyses, number of tooth was related to the classification (p=0.003 vs p=0.044).

The multivariate analyses, including teeth, dentist groups and morphological variables, are presented in Table 2.

Four months after the visual analyses of the tooth pictures used to classify occlusal surface as at-risk, fifteen SFOP dentists (10 females and 5 males) and fifteen GP (8 males and 7 females) were selected at random to complete the same form again. The objective was to evaluate the agreement between the classification of occlusal surface given by

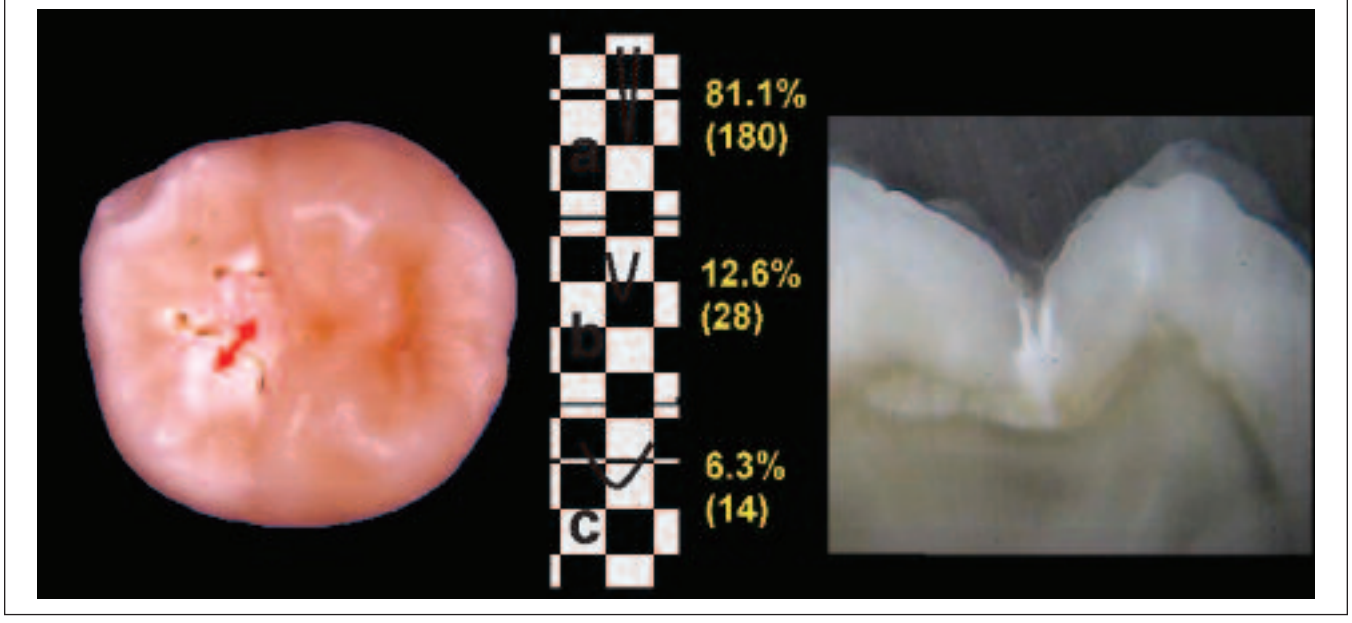


Figure 5. Tooth 4—Evaluation of the occlusal morphology in the arrowed area by 222 dentists and corresponding section of the tooth

Table 2. Multivariate logistic regression model using at-risk occlusal surface as dependant variable among 222 dentists

	At-risk occlusal surface				OR	IC[95%]	p
	No		Yes				
	n	%	n	%			
Tooth							
n°1	11	5.0	211	95.0	1.00		
n°2	149	67.1	73	32.9	0.12	[0.02; 0.64]	0.012
n°3	159	71.6	63	28.4	0.07	[0.01; 0.41]	0.003
n°4	13	5.9	209	94.1	0.37	[0.05; 3.03]	0.355
Stained fissures							
No	331	61.1	211	38.9	1.00		
Yes	1	0.3	345	99.7	504.21	[51.92; 4896. 65]	0.001
Primary fissure morphology							
No	330	74.3	114	25.7	1.00		
Yes	2	0.5	442	99.5	917.53	[181.28; 4644.00]	0.001
Secondary fissure morphology							
No	330	58.2	237	41.8	1.00		
Yes	2	0.6	319	99.4	1022.13	[194.03; 5384.40]	0.001
Dentist group							
SFOP	115	33.4	229	66.6	1.00		
GP	217	39.9	327	60.1	1.42	[0.42 ; 4.80]	0.577

these dentists at the beginning of the study and four months after. We noted high agreement because kappa values were 0.78 for tooth 1 (0.99 for SFOP dentists and 0.76 for GP), 0.58 for tooth 2 (0.76 for SFOP dentists and 0.36 for GP), 0.59 for tooth 3 (0.79 for SFOP dentists and 0.36 for GP), and 0.99 for tooth 4.

The different synonyms used by all the 222 dentists to define the occlusal morphology were deep (n=118), narrow (n=75), unreachable for the toothbrush (51), irregular (n=33), plaque accumulation (n=23) retentive (n=19), crevasse (n=18), sticky (n=17), marked (n=14), crack (n=13), initial lesion (n=10). All the others synonyms were cited less than 10 times (fault, sinuous, coloration, canyon, no self cleaning, navel)

DISCUSSION

Regarding the four pictures, dentists classified the occlusal surface of molars as at-risk when the visual aspect included a stained, narrow or deep primary fissure accompanied by secondary fissures that increase the irregularity of the surface.

The modern approach of caries diagnosis is to perform the exam without probing. The visual inspection of cleaned teeth is recommended to limit the invasion of initial lesions.[19-21] This principle was used in this study, delimiting the occlusal surface in only two, and not three dimensions, for the four tooth pictures in the questionnaire.

As the understanding of this questionnaire could be different according to the type of practice, we included all the SFOP dentists and a large number of GP to facilitate the definition of an at-risk occlusal surface. The SFOP dentists are likely to have greater experience of pit and fissure sealants because they place most of the sealants in France[22]: prevalence of sealants was 6.29% in 12 year-old children.[23] In the USA, prevalence was equivalent, at around 20%, in 5-17 year-old subjects.[14, 24–27] In addition, to decrease any bias related to participation in this study, we selected a sample of all GP registered for a postgraduate diploma in three universities. Consequently, dentists with considerable or little experience of the use of sealants had the same chance of being included in this study. There was no generation-gap between the two groups, so their initial dental training would have been the same. Conversely, sex statistically differed according to the dentist group because females were more numerous among SFOP. Consequently, this variable was kept in the analyses as a confounder.

Our results show that a greater variation on the classification of a surface at risk was noted among GP. Some of them confounded the definition of the arrowed area and the occlusal surface. Only on tooth 3 was the percentage of an at-risk occlusal surface (28.4%) inferior, but not significantly different, from the percentage of the at-risk arrowed area (33.3%) (Figure. 4). This could be due to the poor awareness of dental prevention because low Kappa values concerned only GP.

No more than twenty-five SFOP dentists and GP had the same definition for the four occlusal surfaces: 22 considered all occlusal surfaces as being at-risk whereas three thought they were not. This result, noted by around 10% of the dentists, seems to correspond either to an excessive precaution or to a lack of knowledge probably due to the absence of dentist awareness regarding prevention. We noted in this study that only GP defined all the occlusal surfaces as not at-risk and SFOP practitioners appeared more likely to classify them as at-risk surfaces. Paediatric dental activity could enhance this tendency to prevent caries.

Visual aspect of the primary and secondary fissures was used to classify the occlusal surface as at-risk (Table 2). The odds to define an at-risk surface was higher using secondary fissure morphology than primary fissure morphology. Fur-

thermore, we noted that these morphologic variables were not common among dentists. In a multivariate analyses stratified by dentist group, GP did not use primary fissure morphology to define at-risk occlusal surface whereas SFOP did not use stained fissures.

When pictures showed stained fissures, coloration was considered in the classification of the at-risk surface. Most of the dentists cited coloration to classify tooth 1 (75.7%) and 4 (73.4%) occlusal surfaces as at-risk. On the contrary, this was only cited by 3.6% and 3.2% of the dentists for teeth 2 and 3. In the multivariate analysis (Table 2), stained fissures were less often used to classify an at-risk occlusal surface in comparison to morphological characteristics (primary and secondary fissure morphology). Using the color to classify a surface as at-risk appears to be confusing. Actually, a stained fissure, dark brown or black, is a sign of remineralisation of an initial lesion. If it is yellow or pale brown, it corresponds to an initial lesion. Thus colour indicates tooth integrity. Colour can represent a sign of an initial lesion or of remineralisation, independent of the tooth morphology: It is only the consequence of the individual caries risk. This conclusion is in agreement with the synonyms used by the 222 dentists to describe an at-risk occlusal surface: the word 'coloration' was not used to define at-risk occlusal surfaces.

The majority of the dentists gave the right answer i.e. only tooth 1 and 4 with an at-risk occlusal surface; and this was corroborated by the corresponding tooth sections (Figures 2, 5). Actually, the tooth 1 section showed a very narrow and deep fissure, i.e. a fissure opening type a; and it was the same for tooth 4. In fact 'deep' and 'narrow' were the synonyms most often cited by all the dentists.

Finally the primary fissure should be associated with the adjectives 'narrow' and 'deep' whereas secondary fissures increased the irregularity or the sinuosity of the occlusal surface and 'irregular' corresponded to the fourth synonym most employed. On the contrary, the synonym 'unreachable for toothbrush' seems strange because it depends on a common oral hygiene instrument and not on the tooth itself. Tooth brushes could become more efficient in the next few years, thus the notion of tooth brushing must not be used to define the at-risk occlusal surface. It is the same for 'retentive to probing' because it depends on the use of a probe. Moreover probing remains contra-indicated for initial lesion diagnosis since the diagnosis of caries can only be achieved on a clean and dried tooth observed with magnifying glasses.[28] Finally, 'plaque accumulation' is inadequate because it depends both on the quality of oral hygiene and on the subjects. It is only a possible result of the occlusal morphology.

CONCLUSIONS

The definition of at-risk permanent molars depends on the visual aspect of a cleaned occlusal surface. The surface was at-risk when primary fissures appeared narrow and deep. The presence of numerous secondary fissures increases the irregularity of the occlusal surface and could then participate in the definition of an at-risk surface. The coloration of fissures should not be used in the definition.

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