Uit het Hygiënisch Laboratorium der Rijksuniversiteit te Utrecht

A REPRODUCIBLE METHOD FOR CARIES EVALUATION

V. Pit and fissure caries of molars and praemolars

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Introduction

With radiographs, exposed and evaluated in a standardized way, a good reproducible caries estimation of the proximal surfaces of the posterior teeth (1) and of the upper and lower anteriors is possible (2, 3). However, the occlusal surfaces and the smooth buccal and lingual surfaces are not evaluated in such a survey. In the younger age groups — the most usefull groups for caries experiments — the caries of the occlusal surfaces is numerically much more frequent than the caries of the smooth buccal and lingual surfaces. Therefore we restricted ourselves for the present to develop a reproducible evaluation for the former.

It is impossible to adapt the röntgenological method to the evaluation of caries in these types of surfaces; the buccal and lingual surfaces are invisible whereas the occlusal caries can only be diagnosed in an advance stage. Thus clinical methods have to be used.

The two main problems encountered in the physical caries examination are the difficulty to detect the caries process and the standardisation of the diagnosis. Though the occlusal surface gives unlike the proximals no problems in visibility, still the caries lesion in this surface may be hidden under a seemingly intact fissure. This point strongly hampers a correct standard diagnosis.

It has been tried to standardize the diagnosis with a physical method like the „catching probe" or with a more optical method as for instance the „Moulage system" (4). It is also possible to score only those cavities, that need immediate treatment. A good demonstration of the ultimate possibilities, for the reproducible caries diagnosis of the „catching probe" is given by Parfitt (5). Westin's method also meets a high standard of reproducibility.

The importance of a reproducible caries diagnosis is insufficiently realised. In a large scale survey the sampling error will be reduced to a minimum, but it is possible that the inaccuracy of the diagnosis (also through a shift of standards) leads to a far greater error. In every experiment not only the observation error of the method of caries estimation

has to be measured, but also every precaution must be taken in order to avoid a future shift in caries standards. A duplicate examination of each patient is in fact as usefull and necessary as for example the duplicate in every chemical experiment.

When the observation error is small it is possible to decrease the number of patients materially, though it should remain large enough to keep the sampling error at a low level.

In working with cariespreventives, a differentiation between real caries prevention and a slowing down or arrest of the caries process is necessary. The diagnosis of incipient caries is therefore imperative. This is especially the case in short term experiments — for instance one or two years — as otherwise a large number of the apparent new carious lesions are in fact the small lesions overlooked at the beginning of the experiment and now large enough to be detected (6).

Every method has its own limitations. Although the „Moulage system" is very suitable to diagnose in a standard way the extension of the cavity, it gives less possibilities for the earliest caries lesion. This method is therefore not suited for our purpose.

The method advocated by P a r f i t t has the objection that it neglects the visible side of the lesion. Also the catching of the probe is rather subjective.

The method described in this paper is based on the principle of W e s t i n's Moulage system. We tried especially to diagnose the lower grades of caries, as we wanted to diagnose the true newly formed caries lesions and also to follow the rate of extension of these new lesions. A prophylactic measure may have an influence on the beginning of the caries, or on the extent from this first lesion to a point where a filling is indicated, or on both.

Methods

Before starting the examination the surface is dried with air and cleaned with a sharp probe. The diagnosis is made with the aid of a small mouthlight of high intensity. Incident and transmitted light are used. Especially transmitted light turned out to be very effective as it also gives an impression of the alterations at the bottom and the walls of the fissure. The fissures are valuated in seven grades, which are described below as closely as possible.

Sound: Fissures are clear as well with incident as with transmitted light.

Sound?: Fissures clear with incident light and showing a small dark line with transmitted light.

Caries I: Fissures dark as well with incident as with transmitted light. All is confined to a small dark line.

Caries II: Fissures that are darker and wider; and fissures decalcified along the margins. (Decalcified margins are white with incident and dark with transmitted light).

Caries III: Fissures in which the continuity of the enamel is disturbed (real cavity) or a fissure with distinctly undermined margins (Transmitted light!)

Caries IV: Fissures with a discontinuity in the enamel wider then two and a half millimeter.

Fillings: Fissures that are filled. The eventually present caries is also marked.

As it soon became evident that these descriptions only partially covered the facts we met with, a large number of extracted molars and praemolars were collected and classified as mentioned above. Sets were prepared containing instances of each grade. (fig. 1) These sets, always present and consulted in each dubious case, presented a most important fixation of the different classes and proved an efficient guard against a shift of standard.

In each upper molar two fissures were evaluated separately, one for the mesio-occlusal and a second for the disto-occlusal fissure, including its part on the palatal surface. In the lowers the occlusal fissure and the buccal pit were separately scored. In each praemolar only one fissure was evaluated.

To get a clear picture of this way of caries evaluation and to increase the value of the numbers obtained, each child was examined by two dentists. The mean of both examinations was used as final score. In addition all differences were re-examined by both dentists jointly and brought into line with each other. This re-examination was never used for the score and was only meant as a constant check of both dentists on each other.

Patients

In this paper the results obtained with this method in three groups of about one hundred children (mean age 7.3, 8.3 and 9.3) will be discussed *). As practically none of the children of 7.3 years of age showed any praemolars the examination was limited to the first molars. With the children of 8.3 and 9.3 years of age a large number of praemolars had already erupted and was consequently included in the examination.

Results

Reproducibility of caries estimation

1°. *Number of carious lesions*

The number of carious lesions will be given in two sections: first as the total number of lesions observed, I-F (viz. caries I, II, III, IV and fillings) and second as the number of major lesions, II-F (viz. caries II, III, IV and fillings). It should be realized however that this classification does not necessarely coincide with our classification into the same designations of the proximal lesions as diagnosed from roentgenograms (1,2).

*) In subsequent studies also groups of children of older age (10 and 11) were included in the examinations. The results obtained with these groups are comparable with those discussed in this report.

In table I, II and III the results of the three groups, separately for each dentist, are shown.

TABLE I

	total numbers of fissures	number with caries I-F	number with caries II-F
observer A	760	580	383
observer B	760	567	373

Table I 105 children 7 years of age

TABLE II

	total numbers of fissures	number with caries I-F	number with caries II-F
observer A	869	684	478
observer B	869	679	471

Table II 106 children 8 years of age

TABLE III

	total numbers of fissures	number with caries I-F	number with caries II-F
observer A	1031	813	665
observer B	1031	808	658

Table III 109 children 9 years of age

The striking conformity between the diagnosis of the dentists is obvious. In the children of 8 years of age about 10% and in the children of 9 years of age about 20% of the bicuspids had erupted and were consequently diagnosed. The results obtained in these groups are practically identical to those of the youngest age group. Obviously the evaluation of the bicuspids has no unfavourable influence.

2°. *Number of deviations in diagnosis*

The comparision of the number of carious lesions observed by the two

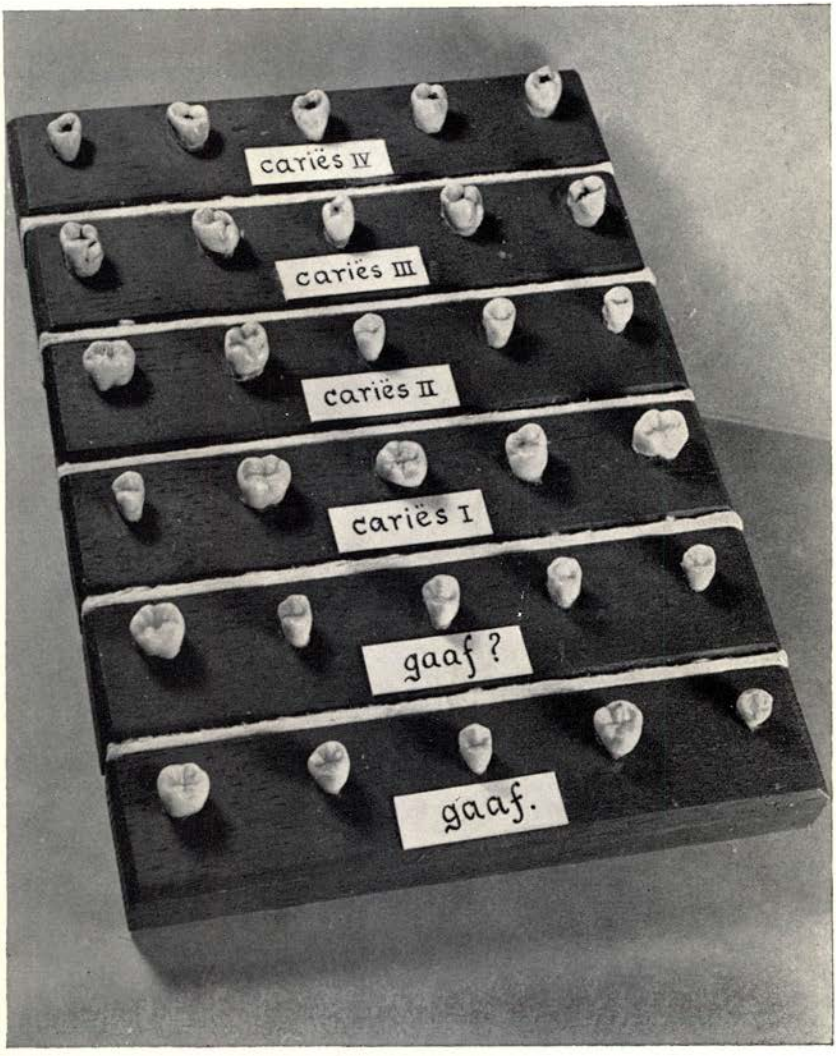

Fig. 1. Set of extracted molars, with instances of each caries grade, used as diagnostic standards. (gaaf = sound)

dentists is a poor test to valuate the exactness and reproducibility of the diagnosis. The similarity of the caries numbers only leads to the conclusion that both examiners attach the same value to the different caries grades. Otherwise the discrepancy in numbers would have been larger.

The total number of fissures differently diagnosed by the two observers is much larger than the difference between total caries numbers, as positive and negative deviations will cancel one another. The sum of positive and negative deviations however determines reproducibility.

As all differences in diagnosis were re-examined, we have a good impression about the kind of fissures that are differently diagnosed. It was found that most deviations concerned borderline cases between two grades. This is to be expected as our caries grades are only artificial limits in the cariesprocess where all grades smoothly marge into each other.

As each of the two observers has in a borderline case in fact a free choice there are four combinations possible. Let us take for example a borderline case sound – caries I. Both observers either make the same diagnosis i.e. both sound or both caries I (no deviation) or a discrepant diagnosis i.e. observer A sound and observer B caries I or the reverse (positive or negative deviation). As the probability of each case is equal, the number of borderline cases will be twice the number of deviations observed.

In table IV the number of deviations are shown for the discussed series, as far as they influence the numbers of I-F and II-F caries lesions.

TABLE IV

Number of children	Age	Caries I-F	Deviations in diagnosis from sound to I				Caries II-F	Deviations in diagnosis from I to II			
			+	—	Total	Differences		+	—	Total	Differences
105	7·3	573[5]	24	37	61	—9	378	29	39	68	—10
106	8.3	681[5]	32	27	59	+5	474[5]	31	24	55	+ 7
109	9.3	810[5]	22	27	49	—5	661[5]	17	24	41	— 7

Table IV Number and direction of deviations in diagnosis
+ and — express the direction of the deviations; observer B more or less than observer A.

The percentage of borderline cases of the total number of examined surfaces appears to be smaller in the older than in the younger age groups. Obviously the age of the children plays a part, possibly because a large number of borderline cases have now become distinctly carious.

The number of borderline cases in these groups amounts 10—15%. So a careful diagnosis of these cases is indispensable. For this reason it is

very profitable to have a duplicate examination by a second observer. Not only does the diagnosis gain in value, and gives a permanent check on the consistency of the judgement of each examiner, but also the observation error can always be calculated. This is a precious datum and indispensable in every well conducted experiment. Again the knowledge not being the only one who makes the diagnosis stimulates the examiners to constant alert.

The number of positive and negative deviations are reasonable well balanced in the different groups. This means that the value attached by both dentists to the diagnosis is the same.

From these deviations the reproducibility of the caries evaluation — that is the percentage of fissures diagnosed in same way by both observers — can be calculated.

For the three groups (table IV) the reproducibility for caries I-F is respectively 92, 93.2 and 95.2% and for caries II-F 91.1, 93.7 and 96%. The reproducibility is nearly alike for both grades.

3°. *Standard deviation of the observed number of carious lesions*

In the same way, as for the numbers of carious lesions in the molars and the anteriors, diagnosed on radiographs (1), the standard deviation of the mean number of carious lesions can be calculated.

In table V the standard deviations for the group of 9.3 years of age are

TABLE V

	Mandibular				Maxillary				Total	per child
	M_1		P_2	P_1	M_1		P_2	P_1		
	o	b			mo	do				
Number of fissures	211	211	36	35	216	216	46	60	1031	9.5
Caries I-F	208	138	10	6	205	198	18	26	810	7.4
Percent Caries I-F	99	65	29	19	95	92	40	43	79%	
Standard error (σm)	1	3	1.2	1.6	1	2	1.9	1.4	4.9	0.47
Percent standard error	0.5	1.8	3.3	4.6	0.5	0.9	4.1	2.3	0.5%	
Caries II-F	191	93	2	1	185	169	5	14	661	6.1
Percent Caries II-F	91	44	6	3	86	78	11	23	64%	
Standard error (σm)	1.9	2.3	0.7	—	1.7	2	1	1.7	4.5	0.43
Percent standard error	0.9	1.9	1.9	—	0.8	0.9	2.2	2.8	0.44%	

Table V. Number of carious lesions I-F and II-F and standard errors. 109 children 9.3 years of age.

presented. As the number of teeth vary, the number of carious lesions as well as the standard deviations are shown also as percentages of the number of fissures examined. As there were no substantial differences between the right and left side, all numbers are only given for right and left together.

From these numbers can be inferred, that the valuation of the praemolars give rise to the largest problems and next to these the buccal pit of the lower molars. The surfaces with the least number of lesions offer most difficulties. It is easy to understand that these surfaces will show most borderline caries, as the caries process just started in these recently erupted teeth. Besides, the small number of praemolars strongly influence the standards deviation.

In general the standard deviations are favourable. For the total of our material it appears that for I-F caries with a cariespercentage of 79 the standard deviation (σm) is 0.5%. For the II-F caries the same numbers are respectively 64% and 0.44%.

Discussion

The method described indeed offers the possibility to a reproducible caries estimation. It also appears that with a good description of the different grades in which the lesions are classified, completed by a series of models, this method leads to quite objective results.

This method is always used along with our radiographic examination for the proximal caries (1,2,3). These numbers are never combined but are treated separately. The factors involved in the caries initiation in proximal surfaces and in fissures are in our opinion thus different, that it is impossible to add these results together. A prophylactic measure may for instance be very effective for proximal caries and not for the fissure caries (7) and therefore it is necessary to differentiate between the two.

Although we realize that these methods take more time than the ordinary survey with probe and mirror, we are with Chilton of the opinion that: „While a good large sample is certainly better than a good small sample, it is important to realize that a good small sample may be much better than a poorly controlled large sample" (8). The chance that the observation error exceeds the sampling error may not be minimized. The observation error can only be controlled when this error is measured each time and a shift in standard is excluded as far as possible.

Again, with every long term experiment in which one cannot be sure that the same investigator(s) will co-operate throughout the experimental period f.i. in fluoridation studies, the necessity for methods of caries evaluation reproducible at any time is quite obvious. In previous years it has become clear that these methods can be handed over to a new investigator without shift in standards. The average time needed for one examination was 5.3 minutes.

Summary

The need for a standardisation of caries estimations is stressed. A clinical method is described for reproducible evaluation of the pit- and fissure lesions of molars and praemolars. Each subject is examined by two dentists using probe, mirror and a small but intense mouthlamp.

To increase reproducibility and prevent a shift of standard a standard reference was prepared consisting of a series of extracted teeth as models of caries grades combined with a description of the clinical features of each grade. This reference was used continually during the survey.

The method was tested in three groups of about 100 children. The reproducibility and the standard deviation of these results proved favourable. The method is meant to be used in scientific surveys together with a standardized röntgenologic method for the proximal surfaces.

Acknowledgment

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Samenvatting

Evenals bij elke proefneming, is het ook bij het onderzoek naar het effect van werkwijzen tot het voorkomen van tandcariës, noodzakelijk over een goede bepalingsmethode te beschikken en tevens de foutengrenzen hiervan te kennen.

Aan een goede methode voor het diagnostiseren van cariës moet de eis gesteld worden dat zij goed reproduceerbaar is. Onder reproduceerbaarheid willen wij verstaan het percentage vlakken dat bij een eerste en tweede beoordeling dezelfde diagnose krijgt. Bovendien moet de waarnemingsfout zo klein zijn, dat het verschil, hetwelk men in hoeveelheid cariës tussen twee groepen personen wenst vast te stellen, significant kan zijn.

Voor de approximale cariës werd reeds een methode uitgewerkt die aan deze eisen voldoet. In de afgelopen jaren heeft deze methode, met bitewing röntgenfoto's, haar bruikbaarheid bewezen.

De laesies van de vrije vlakken zijn, in de door ons gebruikte leeftijdsklassen, niet van groot belang. De andere zeer belangrijke groep van cariëslaesies — nl. de pit en fissuurcariës — kan echter in een onderzoek niet gemist worden.

Voor de pit en fissuurcariës werd een klinische methode uitgewerkt waarbij de fissuren met behulp van een sterk maar klein mondlampje vooral visueel werden beoordeeld. Teneinde zoveel mogelijk te waken tegen elke maatstaf verschuiving werd naast een nauwkeurige beschrijving van de cariësstadia een modelset van geëxtraheerde elementen gebruikt. Op deze wijze werd ook voor de toekomst de maatstaf van de beoordeling vastgelegd.

Bij kinderen van 7, 8, 9, 10 en 11 jaar werd de methode getest. Hiertoe werd ieder kind door twee tandartsen onderzocht.

Zowel de reproduceerbaarheid van de diagnose als de standaardafwijking van de beoordeling bleek gunstig te zijn.

Het is de bedoeling deze methode te gebruiken tezamen met de gestandaardiseerde bitewing techniek.

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