

CONTACT CARIES IN CONNECTION WITH SILVER AMALGAM, COPPER AMALGAM AND SILICATE FILLINGS

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For a long time the most used permanent dental filling materials have been silicate and amalgam, the latter generally in the form of silver amalgam, more rarely as copper amalgam. These three otherwise well-investigated materials have only to a small extent been investigated with regard to their effects on the actual disease, viz. dental caries. The clinical observation that recurrent caries is more usual in connection with silver amalgam fillings than in connection with copper amalgam fillings, was verified in the studies carried out by *Granath & Håkansson-Holma* (1961). That silicate fillings show a lower rate of caries recurrence than do amalgam fillings is also a clinical experience and has been confirmed in studies by *Volker, Bekaris & Melillo* (1944) and by *Lind & Derand* (1963).

The present work aims at illustrating the capacity of the three filling materials to hinder or promote the appearance of caries. These characteristics we call the positive or negative cariostatic effect of the material. In this case a new method was used, with *c o n t a c t c a r i e s*, a concept defined by us, as the indicator.

CONTACT CARIES

If in the case of approximal contact only one of the approximal surfaces is attacked by caries we have, after treatment, a filling which is in contact with an intact surface, for example +1 filled distally, +2 intact mesially.*

* According to the Haderup dental stenography + indicates the upper jaw, — the lower jaw. If the sign is placed to the right of the figure, the right tooth is indicated and vice versa.

A similar form of contact between filling and intact enamel can also occur when a tooth erupts after restoration of the approximal surface of the neighbouring tooth. For example, the mesial surfaces of six-year molars are often filled by the time the second premolars erupt and approximal contacts are established. Often, the intact surface will decay sooner or later. This form of caries we call contact caries. The length of time elapsing before the appearance of contact caries, probably depends in the first place on the cariostatic effect of the filling material. Theoretically, a sufficiently caries-inhibiting filling material can prevent the appearance of contact caries. With the rate of contact caries as an indicator the cariostatic effect of different filling materials may be compared by examining homologous approximal contacts where these materials have been used.

As has been done in this study the method may be used in after-examination of already treated patients. It might also well be used clinically-experimentally comparing different filling materials, both those already known and new ones, with each other or with untreated surfaces.

In the present study were compared (1) the contact caries of silver amalgam and copper amalgam in the distal surfaces of the second premolars and (2) the contact caries of silver amalgam and silicates in the approximal surfaces of the incisors.

I. CONTACT CARIES AT SILVER AND COPPER AMALGAM FILLINGS

Material

The material consisted of the dental examination records of children, all of whom were residents of the town of Falkenberg, Sweden, and who had been systematically treated at the School Dental Clinic, with, as a rule, one annual clearing-up treatment. In the main these patients were treated by one and the same dentist. With no thought of future investigations, this dentist had inserted simple, non-extended copper amalgam fillings in many six-year molars. Ordinarily extended mesio-occlusal silver amalgam fillings had been made in the other carious six-year molars. Copper amalgam was dominant before the eruption of the second premolars, while after this point silver amalgam was dominant.

Most of the information obtained was taken from records regarding children with both copper and silver amalgam contacts. In order to make the groups sufficiently comparable it was necessary, however, to supplement the material with children who had only silver amalgam contacts.

The following data were used,

- (1) Mesial filling of six-year molar.
- (2) Eruption of second premolar.
- (3) Contact caries of the distal surface of the second premolar, equal to filling of this surface.
- (4) Final examination of the teeth.

As the date of eruption does not appear in the records it was defined as being halfway between the date of the last examination at which eruption was still not noted and the date of the examination at which it was first noted, with the reservation that if more than 12 months had elapsed between the two examinations, the date of eruption should be fixed as being six months prior to the date of the first note of the appearance of the tooth in question.

From these data it could be calculated in every examined case of approximal contact for how long the distal surface of the second premolar had remained undecayed in contact with copper or silver amalgam fillings.

It became evident that certain contacts must be disregarded, e.g. those with observation periods less than one year, those where the filling of the six-year molar had been repaired or replaced because of recurrent caries or for other reasons, and those where the information available was either obscure or insufficient. The final material consisted of 131 silver amalgam contacts 82 of which were in the upper jaw and 49 in the lower jaw; and 190 copper amalgam contacts 118 of which were in the upper jaw and 72 in the lower jaw.

Findings

The rate of contact caries in relation to the time elapsed was calculated separately for the upper and lower jaws. The results were in good accordance with each other. Statistical studies showed that the small discrepancies found were not of a systematic nature, and that the figures for the upper and lower jaws could

Table 1

Rate of contact caries of the distal surfaces of the second premolars when in contact with silver amalgam or copper amalgam fillings in the mesial surfaces of the six-year molars.

Period of observation	SILVER AMALGAM			COPPER AMALGAM			Differences in contact caries prevalence
	no. of contacts examined	with caries		no. of contacts examined	with caries		
		no.	percent		no.	percent	
1 year	131	15	11.45	190	6	3.16	8.29 ± 2.81
1½ years	127	36	28.35	178	14	7.87	20.48 ± 4.30
2 —	121	44	36.36	164	24	14.63	21.73 ± 5.12
2½ —	116	61	52.59	146	39	26.71	25.88 ± 6.02
3 —	111	71	63.96	126	54	42.86	21.10 ± 6.49
3½ —	109	84	77.06	108	65	60.19	16.87 ± 6.29

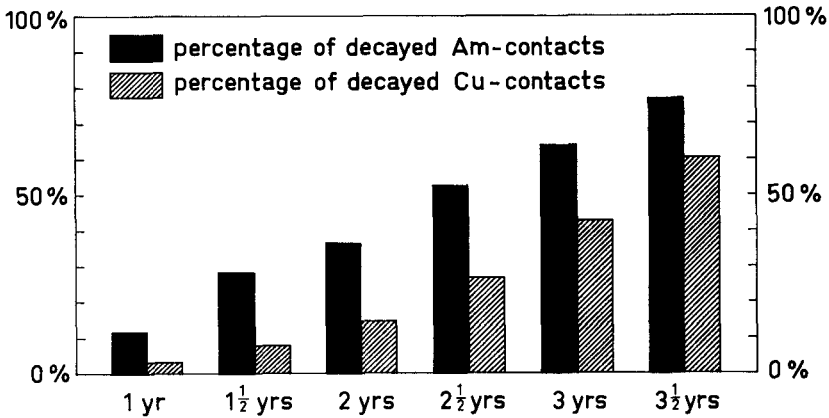


Fig. 1.

therefore be combined. The results are seen in Table 1 and Fig. 1. There is a lower rate and later appearance of contact caries in the case of copper amalgam. In the case of silver amalgam 36.4 % of contact surfaces show decay after two years, as compared to only 14.6 % in the case of copper amalgam. Statistical treatment of these data shows that the differences are highly significant.

Discussion

The differences found in the rates of contact caries can, in the opinion of the authors, hardly be explained in any other way than by the differing cariostatic effects of the filling materials used. Certainly, the two materials were not used in exactly the same way. As opposed to copper amalgam fillings, the silver amalgam fillings are, as mentioned, extended. This should provide fewer possibilities of retention at these contacts. Most of the copper amalgam fillings in the study material are probably made earlier than the silver amalgam fillings. If we assume there is a caries-preventive effect, this would give an advantage to the copper amalgam fillings. On the other hand, an early mesial filling in a six-year molar may often indicate a predisposition to caries. Preparation for fillings — and here it is most frequently silver amalgam fillings — after complete approximal contact is established may have caused damage to the enamel of the distal surfaces of the second premolars. It is, however, difficult to assess the importance of this factor. There is also the risk that in this relatively late treatment of the six-year molars, already existing initial caries in distal surfaces of the premolars may have been missed. Such cases, however, are probably few.

The results demonstrate the superior cariostatic effect of copper amalgam as compared to silver amalgam. Whether silver amalgam has a positive or negative cariostatic effect cannot be determined from the results of the present study.

The reason for the better cariostatic effect of copper amalgam may well be found in the known bactericidal effect of the copper ions (demonstrated by *Türkheim*, 1953, among others) and their ability to reduce acid production of oral bacteria (*Forbes & Smith*, 1952).

II. CONTACT CARIES AT SILVER AMALGAM AND SILICATE FILLINGS

Material

The material originates from the Dental Clinic records of school children who between the ages of 7 and 15 had received a yearly clearing-up treatment. It was necessary to examine a great many dental records in order to obtain a sufficient number of treated

Table II

Rate of contact caries in upper and lower front teeth of approximal surfaces in contact with silver amalgam or silicate fillings in the adjacent approximal surfaces.

	Period of observation	SILVER AMALGAM			SILICATE			Differences in contact caries prevalence
		no. of contacts examined	with caries		no. of contacts examined	with caries		
			no.	percent		no.	percent	
Upper jaw	2 years	56	25	44.64	283	37	13.07	31.57 ± 5.66
	3 —	50	33	66.00	218	62	28.44	37.56 ± 7.50
	4 —	47	39	82.98	171	82	47.95	35.03 ± 8.18
	5 —	44	40	90.01	126	91	72.22	27.79 ± 7.36
Lower jaw	2 years	186	60	32.26	87	3	3.45	28.81 ± 5.48
	3 —	164	82	50.00	72	4	5.56	44.44 ± 6.80
	4 —	148	94	63.51	54	7	12.96	50.55 ± 7.96
	5 —	140	97	69.29	32	10	31.25	38.04 ± 9.61

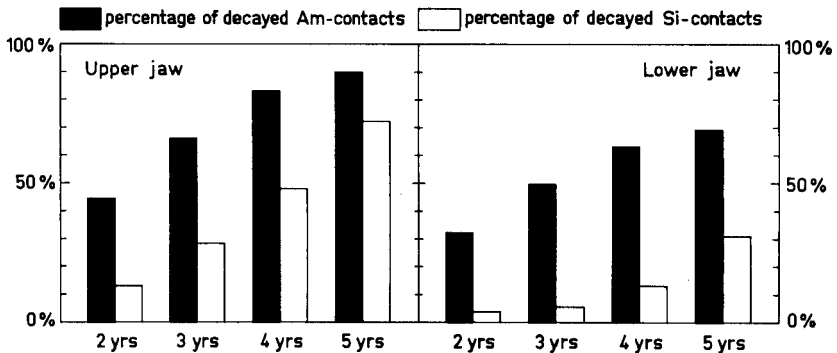


Fig. 2.

unilateral approximal contacts in the incisor area, especially in the case of the less frequent categories, viz. amalgam in the upper jaw and silicate in the lower jaw. The date of the filling was noted, together with the length of the period of observation, and, if contact caries was diagnosed, the date of this diagnosis.

Findings

These are shown in Table 2 and Fig. 2. There is a noticeable difference between amalgam and silicate in both the upper and lower jaws. In the upper jaw 66.0 % of the surfaces in contact

with amalgam fillings showed decay after three years, while surfaces in contact with silicate fillings showed decay in only 28.4 % of the cases. Corresponding figures for the lower jaw are: amalgam 50.0 % and silicate 5.6 %. Statistical treatment of these results show that the differences are highly significant.

Discussion

The difference in occurrence of contact caries which we have demonstrated, may well, in our opinion, be connected with the differing cariostatic properties of the two materials. As far as we have been able to determine from the material at our disposal, amalgam and silicate are used under similar conditions for approximal fillings of the incisors. As for cavity preparation there is hardly any systematic difference of significance for the difference found in the rate of contact caries.

It is natural to ascribe the good cariostatic qualities of silicate to the high fluoride content of this material together with its solubility in the saliva.

Norman, Phillips & Swartz (1960) found that a fairly large quantity of fluoride is released from silicate fillings and that a considerable number of the fluoride ions are absorbed by the surrounding enamel, which in this way acquires a fluoride content far greater than normal and even greater than enamel painted with fluoride. They also demonstrated that filling materials with no fluoride content (*in casu* zinc phosphate cement) deprive the surrounding enamel of fluoride. *Phillips & Swartz* (1957) showed that the solubility of enamel in acid is reduced if the enamel is treated with a filling material containing fluoride, and that it is increased when the enamel is treated with a material which contains no fluoride. These findings, together with the fact that amalgam contains no trace of fluoride, would seem to explain both the different rates of contact caries and the known difference in the tendencies towards recurrent caries.

SUMMARY

The expression "contact caries" is defined and described as a clinically useful indicator of the cariostatic effect of filling materials. The method employed may also be used experimentally.

The comparative studies using this method which have been carried out by the authors on material consisting of systematically treated school children show that (1) copper amalgam has a lower rate of contact caries and consequently a better cariostatic effect than silver amalgam and that (2) silicate cement has a considerably lower rate of contact caries and consequently much greater cariostatic effect than silver amalgam. (3) If the figures for the two examinations are compared, one finds that silicate would seem to have a better cariostatic effect than copper amalgam.

RESUMÉ

CARIE DE CONTACT DANS LES CAS D'OBTURATIONS À L'AMALGAME D'ARGENT OU DE CUIVRE ET AU CIMENT AU SILICATE

Les auteurs donnent une définition de l'expression "carie de contact", et la décrivent comme un indicateur utilisable en clinique pour juger de l'effet cariostatique des substances pour obturations. La méthode indiquée devrait aussi pouvoir être utilisée expérimentalement. Les résultats suivants ressortent des études comparatives faites à l'aide de cette méthode par les auteurs sur un ensemble constitué par des écoliers traités de manière systématique:

I. à l'amalgame de cuivre correspond un degré de carie de contact moindre qu'à l'amalgame d'argent, et par conséquent un meilleur effet cariostatique,

II. au silicate correspond un degré considérablement plus bas de carie de contact, et par conséquent un effet cariostatique beaucoup plus élevé,

III. en comparant les chiffres obtenus dans les deux examens, on trouve que le silicate semblerait avoir une meilleure action cariostatique que l'amalgame de cuivre.

ZUSAMMENFASSUNG

KONTAKTKARIES AN SILBERAMALGAM-, KUPFERAMALGAM- UND SILIKATFÜLLUNGEN

Der Begriff "Kontaktkaries" wird definiert und beschrieben als ein klinisch anwendbarer Indikator für die kariostatische Wirkung von Füllungsmaterialien. Die demonstrierte Untersuchungsmethode dürfte auch experimentell brauchbar sein. Die vergleichenden Untersuchungen, die von den Verfassern nach dieser Methode an systematisch behandelten Schulkindern durchgeführt worden sind, zeigen: 1. Kupferamalgam hat eine geringere Kontaktkariesfrequenz und demzufolge eine bessere kariostatische Wirkung als Silberamalgam. 2. Silikat hat eine beträchtlich geringere Kontaktkariesfrequenz und besitzt daher eine viel grössere karieshemmende Wirkung als Silberamalgam. 3. Vergleicht man die in den zwei durchgeführten Untersuchungen gefundenen Zahlen miteinander, so findet man, dass Silikat wahrscheinlich eine bessere karieshemmende Wirkung hat als Kupferamalgam.

REFERENCES

- Forbes, J. C. & J. D. Smith*, 1951: Studies on the effect of metallic salts on acid production in saliva. *J. dent. Res.* 31: 129.
- Granath, L.-E. & B. Håkansson-Holma*, 1961: The occurrence of certain defects in copper amalgam restorations in the primary dentition. *Odont. Revy* 12: 272.
- Lind, V. & T. Derand*, 1963: Sekundärkaries och kontaktkaries vid silveramalgam- och silikatfyllningar. *Sverig. Tandläk.-Förb. Tidn.* 55: 481.
- Norman, R. D., R. W. Phillips, & M. L. Swartz*, 1960: Fluoride uptake by enamel from certain dental materials. *J. dent. Res.* 39: 11.
- Phillips, R. W. & M. L. Swartz*, 1957: Effect of certain restorative materials on solubility of enamel. *J. Amer. dent. Ass.* 54: 623.
- Türkheim, H. J.*, 1953: Bacteriological investigations on dental filling materials. *Brit. dent. J.* 95: 1.
- Volker, J., B. Bekaris & S. Melillo*, 1944: Some observations on the relationship between plastic filling materials and dental caries. *Tufts dent. Outlook.* 18: 4 (cit. after *Phillips & Swartz*).

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