

The retention of pit and fissure sealants placed in primary school children by Dental Health Services, Victoria

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Abstract

The benefit of a public sector sealant programme for children in Australia is yet to be established. This study evaluated sealants placed by therapists of the School Dental Service in Victoria, between 1989 and 1994, on permanent teeth of children in 15 primary schools in Melbourne. Seven hundred and seventy four children aged 6-12 years were examined in school dental clinics by six calibrated examiners. A total of 5363 sealants placed on 2875 permanent teeth (including 2616 first molars, 91 per cent of sample) up to four and a half years previously was examined. Values for complete and partial sealant retention were highest for premolars (86 per cent, 9 per cent respectively, total 95 per cent); similar for occlusal surfaces of maxillary and mandibular first molars (63 per cent, 30 per cent; 62 per cent, 32 per cent respectively) and buccal pits of mandibular molars (66 per cent); and low for pits/fissures of Carabelli's cusps of maxillary molars (44 per cent). Cross-sectional examination up to 24 months for both maxillary and mandibular first molars indicated average values of 67 per cent complete retention, 27 per cent partial retention, 6 per cent missing; thereafter complete retention decreased and partial retention increased. Sealant failures in the six months post-placement were attributed to technique failure. Regardless of sealant retention, caries experience was low under partially retained or missing sealants (4.5 per cent) and completely retained sealants (0.4 per cent). It is concluded that the SDS sealant programme is a sound preventive dental public health approach.

Key words: Pit and fissure sealants, paediatric dental public health, sealant retention, caries prevention, caries experience.

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Introduction

A major feature of the preventive programme of the School Dental Service (SDS) in Victoria was the implementation in 1988, and expansion in 1990, of fissure sealant placement as a routine clinical procedure. All school dental therapists and student therapists were trained in the technique. The teeth sealed were predominantly first permanent molars. Over one million sealants were placed by the SDS during 1989-1994.

The sealant technique is an efficient and safe means of preventing pit and fissure caries in recently erupted teeth.¹ Simonsen proposed that the placement of a sealant will avoid an initial occlusal restoration which begins the 'molar life cycle' which may proceed later to cuspal fracture, complex restoration and possible extraction.² The possible length of service of sealants has been reported as between 10 and 15 years following placement by a single clinician.^{3,4} From a sample of 231 sealants followed for ten years, Simonsen reported sealant was completely retained on 56.7 per cent of sealed surfaces and partially retained on 20.8 per cent; only one of these was carious. The sealant was missing on 6.9 per cent of surfaces, and 15.6 per cent were carious or restored. After 15 years, 27.6 per cent of sealants in this sample were completely retained, 35.4 per cent partially retained and 10.9 per cent were missing; a further 26 per cent of surfaces were carious or restored. A saving of 4.1 surfaces per child from caries or restorations during the 15 year study period was calculated.⁴

Usually in public sector programmes, multiple clinicians are employed and more variable retention rates would be expected than with a single clinician. Anson *et al.* determined retrospectively the benefit of sealants placed over a 33 month period in a dental school paedodontic clinic by multiple clinicians with various qualifications.⁵ Rubber dam was used

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routinely. At six months, 85 per cent of sealants were completely retained; a failure rate of 4 per cent then occurred at each subsequent six month examination and by 33 months only 67 per cent were completely retained. The initial high failure rate was attributed to poor application technique.⁵ Moisture control is essential for sealant success. The retention of sealants placed regardless of isolation technique has been examined and no significant difference was found whether rubber dam or cotton rolls and suction were used when chairside assistance was available.⁶⁻¹⁰

In a Manitoba public health programme, Cooney and Hardwick examined the retention and benefit of sealants placed on first and second permanent molars up to two years after eruption.¹⁰ Of the 1631 sealants placed during the two year study, 85 per cent were completely retained, 13 per cent partially retained and 2 per cent were subsequently carious or restored. Sealant loss was most prevalent from the buccal surfaces of mandibular molars and the lingual surfaces of maxillary first molars.

In public health programmes, the cost of placing sealants must be less than, or have benefits for outweighing, the placement of a restoration. Sealants are more cost effective when they are placed in caries-prone children,^{11,12} when used as therapy for carious lesions limited to enamel,¹³ when completely retained, when all of the patient's sealants are placed in one visit, when another procedure (such as topical fluoride) is applied at the same visit, and when placed by auxiliaries.¹¹ Simonsen calculated that the monetary cost of a single sealant application, plus reapplication to all areas missing sealant over a ten year period, was two-thirds the cost of restoring carious surfaces in a matched pair group. The saving in relation to the benefits of unrestored tooth surfaces over restored surfaces was emphasized.¹⁴ In comparison with community water fluoridation, fluoride supplements, or fluoride mouthrinses, Garcia concluded that although sealants were more expensive (on an annual cost per person), they have a greater effect in reducing caries on occlusal surfaces.¹⁵

The aim of the present study was to evaluate pit and fissure sealants placed by school dental therapists in Victoria on the permanent teeth of 6-12 year old children during the period 1989-1994, and to report on (a) the retention status of sealants, (b) the caries status of sealed surfaces, and (c) caries experience of the dentitions.

Materials and methods

Ethical approval

Ethical approval for the study was obtained and informed consent was received from all school principals and parents of participating children. The children examined were selected from among those

with sealants placed by therapists of SDS up to four and a half years previously (1989-1994).

Study sample and technique

The sealant material used for most applications was Conseal.‡ Moisture control during placement was obtained predominantly using cotton rolls and suction. Chairside assistance for the therapists was in a ratio of one dental assistant to two therapists. Criteria for sealant placement were as follows: (a) a caries experience expressed as dmfs (primary teeth) or DMFS (permanent teeth) greater than zero, and/or (b) caries-free, retentive pits and fissures on sufficiently erupted occlusal, buccal and lingual surfaces, and pits/fissures of Carabelli's cusp, and/or (c) medical conditions predisposing to caries. School dental clinics in fifteen schools in fluoridated northern and western suburbs of Melbourne were selected. Visual/tactile examinations were performed in a dental chair using dental lighting, mouth mirror, explorer, triplex syringe and suction. School selection was based upon accessibility, clinic availability, large school enrolment, and a high number of sealants placed. Observations were collected by three teams of calibrated examiners each consisting of two final year dental students under the supervision of a dentist or school dental therapist. The study was conducted between May 1993 and February 1994.

Calibration of examiners

At the beginning and end of the study, the examiners were calibrated using 18 fissure-sealed human teeth mounted in stone. The sealants were scored under wet conditions using dental lighting and an explorer. The retention status of each sealant was scored as complete, partial or missing, using the criteria of Simonsen.⁴ An initial inter-examiner reliability of 44 per cent (i.e., all six examiners agreed on 44 per cent of the sealed teeth) was obtained; this reliability doubled with further training. During the study, a consensus between examiners and supervisor was used if retention status was in question and discussions between all teams were held regularly to standardize recording. At the end of the study the 18 sealed teeth were rescored under similar conditions; an inter-examiner reliability of 89 per cent was obtained.

Classification of sealant retention

Sealant retention was recorded at the chairside on forms ready for data entry. At examination, a judgment was made as to whether the morphology of the pits/fissures of Carabelli's cusp (maxillary first molar) and the buccal pit of the mandibular first

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Table 1. Distribution of permanent teeth and surfaces, and retention status of sealants

Distribution	No. of sealed teeth	No. of sealants placed	Retention status		
			Complete (%)	Partial (%)	Missing (%)
By teeth:					
1st molars (Mx and Md)*	2616	5104	2760 (54)	1514 (30)	830 (16)
2nd molars (Mx and Md)†	23	23	17 (74)	6 (26)	0
1st and 2nd premolars (Mx and Md)†	216	216	187 (86)	19 (9)	10 (5)
Incisors (Mx)†	20	20	18 (90)	0	2 (10)
Total	2875	5363	2982 (56)	1539 (29)	842 (15)
By surfaces:					
Mx 1st molars:					
Mesio-occlusal		1314	829 (63)	389 (30)	96 (7)
Disto-palatal		1298	617 (48)	525 (40)	156 (12)
Carabelli's cusp		343	115 (34)	36 (10)	192 (56)
Total	1356	2955	1561 (53)	950 (32)	444 (15)
By surfaces:					
Md 1st molars:		1218	760 (62)	391 (32)	67 (6)
Occlusal					
Buccal		931	439 (47)	173 (19)	319 (34)
Total	1260	2149	1199 (56)	564 (26)	386 (18)
By arches:					
Mx sealants	1495	3091	1676 (54)	964 (31)	451 (15)
Md sealants	1380	2272	1306 (58)	575 (25)	391 (17)
Total	2875	5363	2982 (56)	1539 (29)	842 (15)

*More than one surface sealed for Mx and Md 1st molars.

†Occlusal surfaces only sealed for Mx and Md 2nd molars and for Mx and Md 1st and 2nd premolars, and lingual surface only sealed for Mx incisors.

Mx=maxillary.

Md=mandibular.

molar would have indicated the need for sealant placement. Where a sealant was absent, and a sealant was judged unnecessary, it was assumed that a sealant had not been placed and the surface was not recorded as missing sealant material.

Sealants were classified as completely retained, partially retained or missing, using the criteria of Simonsen.⁴ The completely retained sealant category did not address sealant wear. If some peripheral fissures were uncovered following sealant wear, but no ledges were present, the sealant was classified as completely retained (ledges indicate bulk loss of some adjacent sealant). Partially retained sealants were those where, following either wear or material loss, part of a previously sealed pit/fissure was exposed. Missing sealants were those where no trace of sealant was detectable.⁴

Caries experience

The caries experience of individual teeth and dentitions were recorded using the criteria of Radike;¹⁶ dmfs (primary teeth) and DMFS (permanent teeth) scores were calculated. Radiographs were not taken, but any current radiographs available in the records were reviewed. All parents were notified of the treatment needs of their child and referred to the nearest SDS clinic for treatment.

Distribution of children

A total of 774 children (381 boys, 49 per cent of sample; 393 girls, 51 per cent) aged 6-12 years

(mean age $\pm$ SD: boys: 10.0 $\pm$ 1.4, girls: 9.9 $\pm$ 1.2) was examined. The majority (87 per cent) were aged 8-11 years at examination. Parental consent rate for study participation ranged from 50-90 per cent between schools. Higher parental consent rates occurred in schools where the principal was enthusiastic about the study and encouraged prompt return of the consents.

Statistical management of the data

Data on sealant retention status and caries experience of individual teeth and dentitions were entered onto a computer spread sheet [Excel]§ and subsequently analysed using the computer statistical package SPSS/PC4.0.,

Results

Sealant retention

Table 1 shows the distribution of permanent teeth and surfaces examined, and retention status of the sealants. A total of 2875 once-sealed teeth was examined: 2616 first molars (91 per cent of sample), 23 second molars (0.8 per cent), 216 premolars (7.5 per cent), and 20 maxillary incisors (0.7 per cent). A total of 5363 sealant placements was examined; these were predominantly on maxillary and mandibular first molars (5104, 95 per cent of sealant placements). Complete and partial retention of

§Microsoft Corp, Redmond, Washington, USA.

,MJ Norusis SPSS Inc (1989), Chicago, Illinois, USA.

Table 2. Retention status of occlusal sealants of first permanent molars by time

Distribution	Months since placement of sealant	Retention status				Total
		Time frame	Complete (%)	Partial (%)	Missing (%)	
Maxillary molar sealants	1-5.9	I	102 (67)	40 (27)	9 (6)	151 (100)
	6-11.9	II	220 (67)	91 (28)	16 (5)	327 (100)
	12-17.9	III	184 (69)	64 (24)	29 (7)	268 (100)
	18-23.9	IV	141 (64)	63 (29)	16 (7)	220 (100)
	24-35.9	V	93 (54)	55 (32)	23 (13)	171 (100)
	36-48.0	VI	49 (45)	54 (50)	5 (5)	108 (100)
	Total		789 (63)	367 (29)	89 (7)	1245 (100)
Mandibular molar sealants	1-5.9	I	85 (68)	33 (26)	7 (6)	125 (100)
	6-11.9	II	199 (69)	74 (26)	13 (5)	286 (100)
	12-17.9	III	137 (60)	78 (34)	12 (6)	227 (100)
	18-23.9	IV	134 (68)	53 (27)	9 (5)	196 (100)
	24-35.9	V	75 (52)	56 (39)	14 (9)	145 (100)
	36-48.0	VI	29 (34)	53 (62)	3 (4)	85 (100)
	Total		659 (62)	347 (33)	58 (5)	1064 (100)

sealants was highest on the occlusal surfaces of premolars (86 per cent and 9 per cent respectively), and on the lingual surfaces of maxillary incisors (90 per cent). Lower values were noted for first molars (54 per cent and 30 per cent respectively). Overall, 56 per cent of sealants were completely retained, 29 per cent partially retained, and 15 per cent were missing.

With reference to first molar surfaces, Table 1 shows higher values for complete retention on mesio-occlusal and occlusal surfaces of maxillary and mandibular first molars than for disto-palatal and buccal surfaces of these teeth. The pits/fissures of Carabelli's cusps were prone to sealant loss, as shown by low values for complete retention (34 per cent). Overall, sealants placed in maxillary and mandibular arches showed similar patterns of retention.

Caries experience of once-sealed surfaces

Of the 2982 completely retained sealants, 1 per cent of sealants showed marginal discoloration or shadowing when viewed under reflected or transmitted light, although the sealant and sealant margins appeared intact clinically. As noted previously, confirmatory radiographs were not taken. Of the 1539 partially retained sealants, 10 per cent had unrestored caries associated with sealant loss from pits/fissures. Among 842 missing sealants, 10 per cent had unrestored caries associated with areas of sealant loss, and 5 per cent had restorations in place.

Retention status of molar sealants by time

Table 2 shows the retention status of occlusal sealants on maxillary and mandibular first molars cross-sectionally by time. It should be noted that these are not longitudinal data and therefore do not report the retention of sealants followed sequentially from placement to 48 months. For ease of presentation the time since sealant placement has been divided into Time frames. Each Time frame has been identified by a roman numeral from I to VI. Of maxillary molar sealants examined within six

months of placement (Time I), 67 per cent were completely retained. The remaining sealants examined at this time were partially retained (27 per cent) or missing (6 per cent). The proportions of completely retained maxillary sealants noted thereafter remained relatively constant (64-69 per cent). The proportion of partially retained sealants increased thereafter in Time I and Time II to 32 per cent and 50 per cent, respectively.

Mandibular molar occlusal sealants followed a similar pattern of retention to maxillary occlusal sealants over time (Table 2). Of mandibular sealants examined within the first six months of placement (Time I), 68 per cent were completely retained. This proportion in Time II, III and IV was 60-69 per cent. The decline in the proportion of completely retained sealants in Time V and VI paralleled the changes in maxillary molar sealants. Again, the greatest variation after Time V occurred in the proportion of partially retained sealants, which increased to 62 per cent by Time VI.

The retention of molar occlusal sealants reviewed at Time I, II and III was examined with reference to the schools the children attended. Complete sealant retention varied widely between schools, ranging from 33-100 per cent at Time I, 31-96 per cent at Time III, and 24-100 per cent in Time IV. In seven schools with the highest number of sealant placements (range 194-325 sealants), the distribution of those completely retained was 52-72 per cent partially retained 22-43 per cent, and missing 4-9 per cent. A wide standard deviation for the mean number of missing sealants in Time I indicated a high short term sealant loss at some schools.

Distribution of caries experience of dentitions

Table 3 summarizes the caries experience of the children. The mean dmfs for children aged 7-12 years ranged from 6.9 to 1.6. The number of decayed surfaces differed little between age groups, but the number of filled surfaces decreased ten fold from age seven to 12 years. The mean DMFS

Table 3. Distribution of caries experience in primary and permanent teeth of 6-12 year old children

Teeth	Age (years)	No of children (n=774)	dmfs or DMFS mean (SD)	Decayed surfaces mean (SD)	Filled surfaces mean (SD)	Missing surfaces mean (SD)
Primary	6	7	1.86 (2.0)	0.7 (1.2)	0.4 (0.8)	0.7 (1.9)
	7	41	6.9 (7.7)	0.7 (1.3)	5.1 (5.4)	1.1 (3.6)
	8	130	5.0 (5.7)	0.8 (1.6)	3.6 (4.0)	0.6 (3.0)
	9	192	4.8 (6.5)	0.9 (1.8)	2.9 (4.0)	1.0 (3.7)
	10	204	3.0 (4.0)	0.8 (1.5)	2.0 (3.0)	0.2 (1.0)
	11	145	2.2 (4.3)	0.7 (1.5)	1.3 (2.7)	0.2 (1.7)
	12	41	1.6 (3.8)	0.6 (1.1)	0.5 (1.1)	0.5 (2.4)
Permanent	6	7	1.3 (2.0)	0.1 (0.4)	1.1 (2.0)	0
	7	41	0.8 (1.5)	0.3 (0.9)	0.5 (1.1)	0
	8	130	1.0 (2.0)	0.4 (1.3)	0.6 (1.3)	0
	9	192	1.5 (2.2)	0.4 (1.0)	1.0 (1.8)	0 (0.4)
	10	204	1.6 (2.3)	0.7 (1.5)	0.9 (1.7)	0 (0.4)
	11	145	2.1 (2.6)	0.8 (1.5)	1.3 (2.1)	0 (0.01)
	12	41	3.5 (3.5)	0.9 (1.6)	1.8 (2.1)	0.7 (2.3)

ranged from 1.3 to 3.5. The filled surface component of the score exceeded the decayed component by a factor of up to twofold. Overall, there was an increase in the number of decayed or filled surfaces from seven to 12 years of age. The number of missing permanent surfaces was very low below age 12 years.

Comparison of mean dental caries experience was made between subjects with first molars having all four sealants that were (a) completely retained, (b) completely or partially retained, or (c) partially or totally missing (Table 4). There was no statistically significant difference in caries experience for subjects having all four sealants either completely retained, completely/partially retained, or partially/totally missing.

Discussion

This clinical study examined retrospectively the retention of sealants placed by therapists over a four and a half year period in the SDS in Victoria. Overall, the complete retention rate of 56 per cent was lower than reported in prospective studies in which the retention of sealants placed by auxiliaries was determined. Complete retention values ranging from 80-98 per cent after 12 months have been reported in such studies.¹⁷⁻¹⁹ The percentages of partially retained (29 per cent) and missing (15 per cent) sealants noted in the present study were also greater than those found in other studies. However, the present study was retrospective in design and cannot be compared with prospective studies where

retention criteria, number of clinicians, placement techniques and study length all differed. In an investigation not dissimilar from the present study, Anson *et al.* examined retrospectively the retention of sealants in a dental school paedodontic clinic using multiple clinicians, and found that while 85 per cent of sealants were 'all present' at 6 months, only 67 per cent were present at 33 months.⁵ These results are closer to those reported in the present study.

Sealant losses in the present study were predominantly from the pits/fissures of Carabelli's cusp on maxillary first molars (which are not caries-prone) and buccal pits of mandibular first molars (which are caries-prone). This is in agreement with the observations of Cooney and Hardwick.¹⁰ Possible reasons for these failures include selection of insufficiently erupted teeth, difficulty in isolation, inadequate etching, and the possible omission of these areas when sealing other surfaces. The dental records kept did not describe accurately the surfaces actually sealed, and some assumptions had to be made retrospectively as to whether a sealant would have been indicated at these sites. Considering possible reasons for failure, Anson *et al.* listed poor placement technique (inadequate moisture control, not sealing all pits/fissures, inadequate etching, rinsing and drying, insufficient curing time), material wear, non-sealant failure (extraction of tooth, proximal caries, exfoliation), and finally failure due to a combination of these factors.⁵ The factor most likely contributing to sealant failure in the present study was inadequate moisture control, as only 67-68 per cent of sealants reviewed within six months of placement were retained completely, and isolation by rubber dam was not a routine procedure.

Premolar sealants were more often completely retained than molar sealants, agreeing with the findings of others.^{5,18} The reasons for this include their more recent placement, placement in older and more cooperative children, easier isolation than for the more posteriorly-placed molars, and their exposure to less occlusal loading than molar sealants.

Table 4. Comparison of dental caries experience by occlusal sealant retention status of first molars

Subjects with four sealants	N (subjects)	Mean DMFS (SD)
Completely retained	132	1.7 (2.3)
Completely or partially retained	342	1.7 (2.4)
Partially retained or completely missing	34	1.7 (2.4)

Clinical evidence suggests that sealant loss (retention failure) occurs in two phases: firstly, an initial loss due to faulty technique (such as moisture contamination), followed by a second loss associated with material wear under the forces of occlusion.²⁰ Therefore, it seems reasonable to assume that tooth selection or technique failure at the time of sealant placement were responsible for the majority of partially retained or missing sealants within the first six months of placement. This was most likely due to inadequate moisture control. The assumption that technique failure was the major factor responsible for the relatively low percentage of completely retained sealants at 6 months is supported by the results up to 24 months. Presumably sealants which were placed in less than ideal conditions would fail within the first six months of placement, while those which were placed in ideal conditions (i.e., good moisture control and placement technique) would remain intact up to two years. Thus, after the initially high failure rate of sealants within six months (32 per cent), there was little change in the failure rate from this time up to two years, as the results indicate (failure rate at 24 months of 36 per cent). The data examining the association between the retention of molar occlusal sealants and the school attended by the children reflect a high short term loss in some schools. This could also be attributed to technique failure associated with individual clinicians at particular schools.

It is likely that factors other than technique failure are responsible for the sharp increase in partially retained and missing sealants at time intervals of 36 and 48 months. Since technique failure cannot account for this rise in failed sealants after 24 months, other factors such as vertical wear, occlusal trauma, local conditions, and individual variation must be considered. The greater problem of moisture control in the mandible than in the maxilla cannot account for the lower proportion of completely retained sealants in the mandible (34 per cent) compared with the maxilla (45 per cent) at 48 months. Technique failure cannot be considered a factor in sealant failure at 36 to 48 months. Some of the factors previously indicated as contributing to sealant failure at this time probably occurred.

The caries scores for the children examined were high by local standards in Victorian fluoridated communities. The relatively high dmfs and DMFS scores for the children selected to have sealants indicate that the criteria for their inclusion in the SDS sealant program were appropriate. The high DMFS scores for 10-12 year olds confirms the need for the preventive benefit of sealants on newly erupting permanent teeth in this age group.

A recent study analysed the influence of caries history in primary teeth (dft index) on the success of sealants over a four year period, and found that the higher dft, the higher the risk of sealant failure.²¹

However although not longitudinal in design, the present study did not find a difference between sealant retention status and caries experience of the subjects.

The concept of efficacy of a sealant programme has been approached in a number of ways by different authors. McCune *et al.*²² defined efficacy in terms of net gain (an estimate of how many teeth were saved due to sealant placement), and per cent effectiveness (the net gain as a percentage of the total number of carious control teeth). Weintraub²³ evaluated efficacy by the percentage effectiveness (a statistic used in clinical trials to compare the caries rate of sealed and unsealed teeth), the percentage of completely retained sealants, and the percentage of sealed teeth which became carious and/or restored, and the reapplication rates. Simonsen¹⁴ evaluated efficacy in terms of cost effectiveness and the odds ratio (the odds of an unsealed tooth becoming carious). In the present study, efficacy was viewed in terms of the prevention of caries on the sealed surfaces of molar teeth in dentitions considered to be at high risk for dental caries. On first permanent molars, regardless of sealant retention, 94 per cent of all sealed surfaces were sound. For all sealed teeth, 99 per cent of surfaces with completely retained sealants were sound, compared with 90 per cent of surfaces with partially retained sealants and 85 per cent of surfaces with missing sealants. This suggests that sealants can continue to prevent caries even when they appear clinically to be partially or completely lost.

Applying the 1993 Veterans Affairs Administration scale of fees, the value of services per child for this preventive programme was approximately \$95 (2875 sealed teeth at \$25.50 per tooth, for 774 children, averaging 3.7 sealed teeth per child). It should be noted that this value of services is not equitable with actual cost of service delivery, since in most instances several teeth were sealed at one appointment and sealants were placed by therapists. Multiple sealant placements in a single appointment reduce the cost per sealant. Since 91 per cent of all placements were on first permanent molars (the most caries-prone teeth), and 94 per cent of all once-sealed surfaces were sound, this SDS sealant programme is considered a sound preventive dental public health program.

The issue of high early losses, and in particular those due to moisture contamination in hard-to-isolate clinical situations, needs to be addressed by the SDS. For example, the recently reported technique modifications of incorporating wet bonding under the sealant, or using interim sealants, could be considered. Improved retention and significant increases in bond strength of sealant to both saliva-contaminated enamel and uncontaminated enamel have been observed *in vitro* and in clinical trials following the application of an enamel bonding

agent after acid etching.^{24,25} A clinical trial comparing a glass ionomer (polyalkenoate) cement with a bis-GMA resin as a sealant material found no difference in cariestasis after four years, despite markedly lower retention.²⁶ Although glass ionomer sealants may appear clinically to be missing, scanning electron microscopy of fissures has shown the cement to remain in the deeper recesses, acting as a plug.²⁷ Williams *et al.*²⁷ suggest that polyalkenoate cements used as sealants should be regarded as 'fluoride depot materials' rather than fissure sealants. These materials could be considered by SDS as interim sealants in clinical situations where it may not yet be possible to place a bis-GMA sealant under excellent moisture control, for example on partially erupted teeth or in cases of limited cooperative behaviour. Later, when conditions become more favourable, a resin sealant could be placed.

In summary, regardless of sealant retention rates, the caries experience of the once-sealed surfaces in the SDS sealant programme was low, indicating that sealants contribute significantly to dental public health. In the Victorian SDS sealant programme, sealant retention could be improved by utilizing at all times a precise sealant application procedure which includes optimal moisture control.

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