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A clinical comparison of sealant and amalgam in the treatment of pits and fissures

*Part 2: Clinical application and Maintenance during an 18-month period**

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Abstract

The results obtained after 18 months of clinical study, comparing sealant application for the prevention of caries with amalgam restorations on the pit and fissure surfaces of permanent molars, are analyzed to document the maintenance required for optimum success with both modes of treatment. An accurate summary of operating time used to accomplish each treatment is presented and various aspects of treatment failure are illustrated. The cumulative mean time required to place and maintain the amalgam was 13 min:58 sec, whereas the cumulative time invested in the sealant treatment was 8 min:45 sec. The data support application of pit and fissure sealant as a treatment within the specific limitations of a controlled preventive program and professional supervision.

Introduction

The majority of previous clinical studies involving pit and fissure sealants have evaluated the effective-

ness of a single sealant application to reduce the incidence of caries in relation to that found on similar untreated control teeth in the same mouth.[1-10] Long-term results have indicated uniformly that there is a loss of material with time that can vary according to the material used,[7] the technique of application,[8] and the characteristics of the patient population.[9] Clinical efficacy likewise is subject to the same variables, but a significant caries reduction has been documented in all of the more recent studies. In a previous report of this investigation (Part I),[11] results were presented after 18 months involving reapplication of sealant when necessary at six-month recalls to maintain a clinically-intact sealant coating.

Previous attempts to evaluate the time utilized to adequately apply pit and fissure sealant[12-15] have been based upon large population samples and have shown a relationship to the staff utilized, the setting time of the material, and other variables within the clinical environment. Most studies have equated the time spent during an initial placement to the efficacy of the treatment on a cost-per-service basis, but very little attention has been given to the maintenance treatment that can make sealant application truly effective as part of a preventive program.

It is the objective of this paper to present a time analysis of the maintenance required for both the sealant treatment and the paired amalgam restorations during the 18-month study period. Early treatment failures are documented and their relationship to clinical technique is discussed.

Methods and Materials

After careful screening, a population of 110 paired molar surfaces was selected, 55 noncarious surfaces were treated with a chemically-activated filled resin sealant* while the contralateral 55 carious surfaces were restored with one surface amalgam** restorations. All operating procedures were performed by two experienced practitioners with the aid of trained auxiliary personnel. Standard clinical techniques were utilized for each method of treatment, the details of which were given in a previous publication (Part I).[11]

Both the sealant coating and the amalgam restorations were evaluated at baseline and at six-, 12-, and 18-month recall and maintenance procedures implemented when judged necessary to improve clinical performance of the treatment. Any defect in the sealant coating that could expose an underlying fissure was retreated in a manner identical to that used at initial application. If a crevice along the margin of an amalgam was severe, an attempt was made to recontour this area.

At the initial appointment and during the recall visits, a stopwatch was used to record the operating time required to perform the various procedures. Time was recorded to the nearest second for every step of treatment both initially and when appropriate additions were made for the maintenance treatment required at subsequent recall visits.

Results

An effort was made to establish the operating time necessary to adequately maintain a sealant treatment within the framework of a complete dental care program. The treatment required to maintain both procedures during the 18 month study period is presented in Table 1. Of the 10 sealant coatings that required adjustment with a carbide finishing bur immediately after treatment, seven were on mandibular molars and were related to the excessive application of material. The sealant required the greatest amount of maintenance and selective retreatments were required at every recall examination. The maxillary teeth showed the greater incidence of failure after six months, but the mandibular teeth had more severe problems after 18 months. The retreatment rate was highest (9) at six months and significantly lower after both 12 months (5) and 18 months (4). Only minimal margin adjustment was necessary to maintain the amalgam.

The mean values for treatment time in minutes:seconds among all patients are presented in Tables 2 and 3. Placement of a Class 1 amalgam restoration (Table 2), from administration of anesthesia to polishing one week later, took a mean time of 13 min.:51 sec. There was no necessity for maintenance care at six months; one surface required a margin adjustment (a total time of 2 min.:28 sec.) at 12 months; and three surfaces required margin recontouring (a total time of 2 min.:53 sec.) at 18 months. The adjustments increased the total mean treatment time for amalgam to 13 min.:58 sec. after 18 months. The sealant (Table 3) was placed without anesthesia and the initial treatment involved a mean time of 6 min.:20 sec. for each surface treated. At the baseline evaluation one week after application, ten surfaces were adjusted mechanically (a total time of 8 min.:6 sec.) and two surfaces required reapplication (a total time of 9 min.:30 sec.).

*Kerr Sealant, Kerr Manufacturing Company, Romulus, MI (No longer commercially available).

**Tytin, S. S. White Division of Pennwalt Corp., King of Prussia, PA.

Table 1. Treatment required to maintain efficacy

		Baseline		Retreatment		
	Number Treated	Adjust	Retreatment	6 Months	12 Months	18 Months
Sealant						
Maxillary:	37	3	2	7	3	0
Mandibular:	18	7	0	2	2	4
Total:	55	10	2	9	5	4
Amalgam						
Maxillary:	37	0	0	0	0	2
Mandibular:	18	0	0	0	1	1
Total:	55	0	0	0	1	3

Table 2. Time analysis for amalgam restoration and maintenance (mean value in minutes:seconds)

				Margin Recontouring			
Anesthesia Isolation	Restoration	Polish	Baseline Total	6 Months	12 Months	18 Months	Cumulative Total
5:41	4:55	3:15	13:51	0:00	0:03*	0.04**	13:58

* 1 surface repolished — 2:28
** 3 surfaces repolished — 2:53

Table 3. Time analysis for sealant treatment and maintenance (mean value in minutes:seconds)

	Baseline			Retreatment			
Initial Treatment	Adjustment	Retreatment	Total	6 Months	12 Months	18 Months	Cumulative Total
6:20	0.09[a]	0.10[b]	6:38	0:59[c]	0.35[d]	0:33[e]	8:45

Note: [a] 10 surfaces adjusted — 8:06
[b] 2 surfaces retreated — 9:30
[c] 9 surfaces retreated — 51:23
[d] 5 surfaces retreated — 30:16
[e] 4 surfaces retreated — 27:40

After six months, nine surfaces were retreated (a total time of 51 min.:23 sec.); after 12 months, five surfaces were retreated (a total time of 30 min.:16 sec.); and after 18 months, four surfaces required reapplication (a total time of 27 min.:40 sec.). The maintenance treatment increased the total mean time invested per surface for a sealant program to 8 min.:45 sec. after 18 months.

In analyzing the sealed surfaces that required retreatment (Table 4), there appeared to be no consistent pattern to the way in which failure occurred. There were 12 surfaces that were retreated only once during the 18 months, three surfaces that were retreated twice, and only one surface that was retreated three times. Of the 55 surfaces treated initially, 51 surfaces were available at the 18-month recall and 35 of those surfaces (68.6 percent) endured the 18 months without retreatment.

Table 4. Analysis of sealant treatment failure

	Surfaces Evaluated at 18 Months	Number of Retreatments Performed				
		0	1	2	3	4
Surfaces	51	35	12[a]	3[b]	1[c]	0
Percent	—	68.6	23.5	5.9	2.0	0

Note: [a]represents: 7 retreated at 6 months
2 retreated at 12 months
3 retreated at 18 months

[b]represents: 1 retreated at baseline and 6 months
1 retreated at 6 months and 12 months
1 retreated at 12 months and 18 months

[c]represents: 1 retreated at baseline, 6 months, and 12 months.

Discussion

The relatively high incidence of early sealant failure and the need for retreatment during the first six months (Table 1) is an indication that the initial bond between sealant and enamel was insufficient to withstand the stresses of the oral environment. Of the nine surfaces retreated with sealant at six months (Table 4), seven were sustained for the remaining 12 months without further problem and three required additional retreatment at either 12 or 18 months. The leading

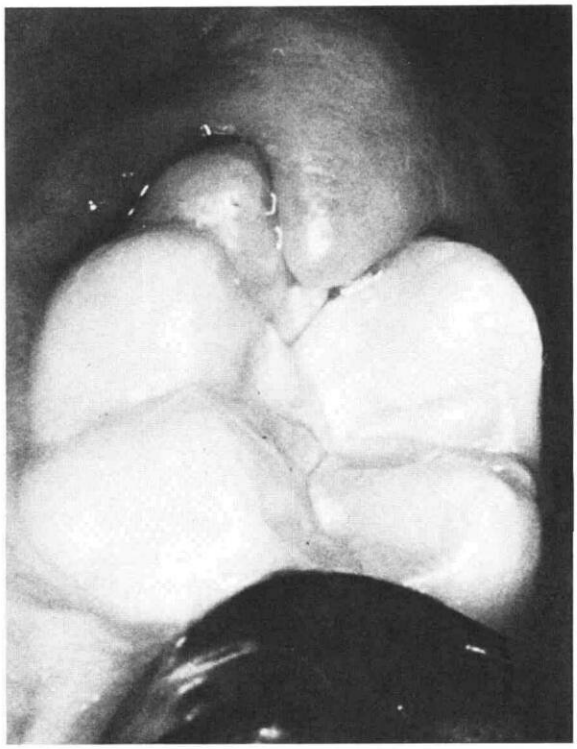
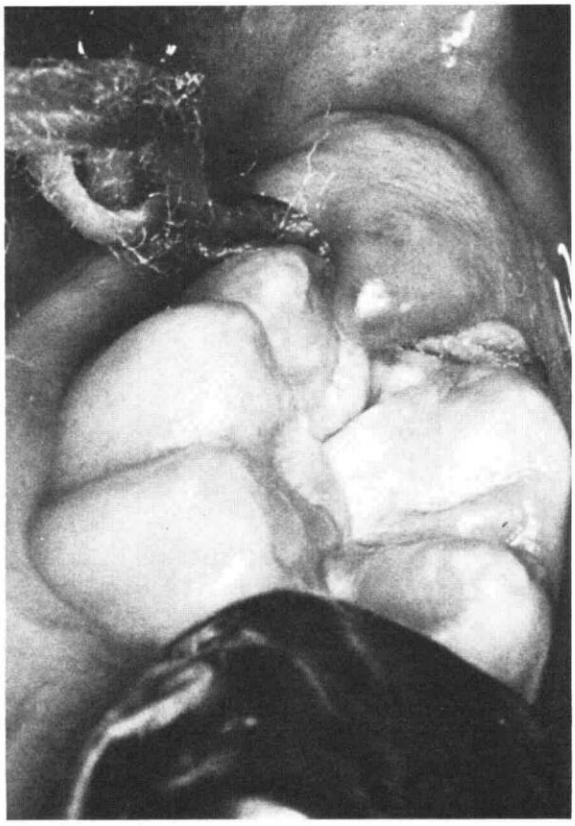


Figure 1. Partially erupted first mandibular molar. (A) Preoperative view with tissue tab extending onto distal-occlusal surface; (B) Placement of gingival retraction cord.



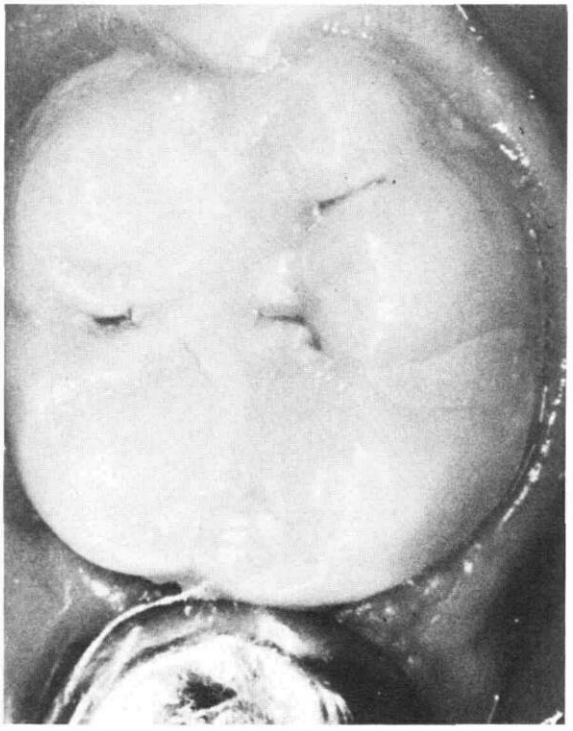


Figure 2. Severe sealant deterioration requiring retreatment, 18 months.

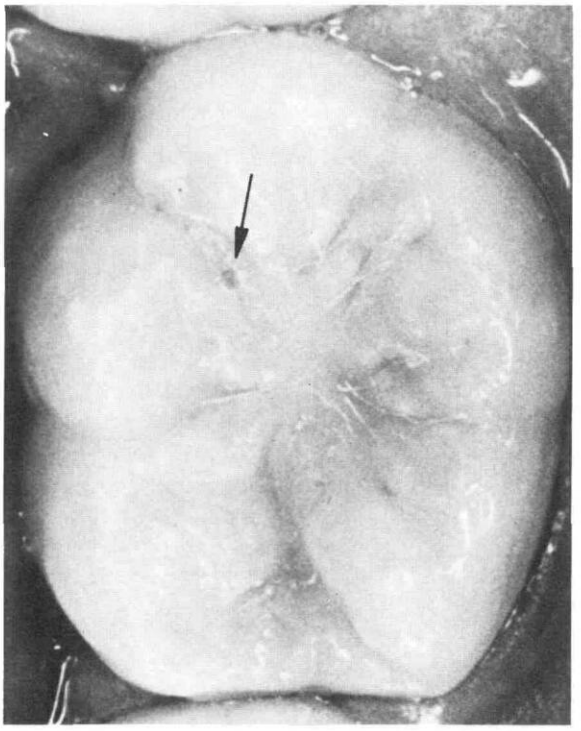


Figure 3. Minor sealant deterioration requiring retreatment, 18 months.

cause of adhesive failure at the enamel interface is contamination of the freshly etched enamel substrate with oral fluids; therefore, emphasis must be placed upon effective isolation procedures during application of the sealant. A typical isolation problem encountered during the study is illustrated in Figure 1. Tissue retraction cord can be gently inserted under the residual tag of tissue without anesthesia to provide access and a measure of isolation to the distal pit of a mandibular molar. A rubber dam may be the most effective technique to insure isolation but it may necessitate waiting on tooth eruption until the clamp can be secured, risking the additional exposure time to a cariogenic environment.

There is little information available to define the factors associated with clinical wear of a sealant coating that indicate the need for a retreatment procedure. An idealistic approach was taken in this study, and every defect in the coating that could potentially expose an underlying fissure or develop increased plaque retention was recoated with sealant. An example of relatively severe deterioration after 18 months is shown in Figure 2. On the occlusal surface, the sealant has either been abraded or thin edges have fractured during function, exposing the buccal, lingual and distobuccal fissures with evidence of stain penetrating under the remaining material. The exposed fissures were determined to be non-carious after mechanical removal of the loose sealant edges. Application of a new sealant coating restored continuous coverage to the exposed fissures and created a smooth margin junction.

A comparable sealant coating at the same 18-month recall period (Figure 3) illustrates a similar type defect along the distal buccal fissure. The clinical evaluation showed no margin discoloration and only an explorer catch of the margin along the exposed area. Although the severity of the defect is greater and the potential for caries development much more likely in the previous patient (Figure 2), both teeth require retreatment and the expenditure of similar time and material.

A much less severe problem, but one that is more likely to occur in the use of a filled resin system with its increased viscosity, is the exposure of an air void during clinical function (Figure 4). This observation appeared more likely during the early stage of clinical service, and was evident at insertion as subsurface porosity. Some of the larger surface voids were found to retain plaque and debris and it was impossible to determine by explorer examination whether the base of the void was in resin or exposed underlying, caries-sus-

ceptible enamel. Therefore, a conservative approach necessitated the retreatment of these defects. A small round carbide bur was used at conventional speed to clean out the void and establish a sound base for the new material. In nearly all cases, the base of the void was still within the sealant material, but this judgment could not be made solely from clinical evaluation.

One area that was in question prior to this study was the effectiveness of bonding new sealant material over an established coating to cover a clinical defect. In every instance the bond between materials was effective and there was no visible evidence at succeeding recalls that retreatment had been performed.

Although there may be a more secure feeling related to the clinical performance of amalgam restorations, they were not without problems. The mandibular molar shown in Figure 5A presents a preoperative occlusal morphology conducive to plaque retention and suitable for sealant application. In placing a typical Class 1 amalgam restoration (Figure 5B), a great deal of sound tooth tissue had to be removed to accomplish appropriate extension through the pits and fissures present. The resulting restoration after 18 months of clinical service (Figure 5C) is functioning well although there is visual evidence of margin deterioration. A more severe type of amalgam margin failure with crevice formation at the interface (Figure 6) became evident after 18 months (Table 4). These margin defects required judicious recontouring of the amalgam adjacent to the crevice with rotary instruments to reduce the potential for plaque accumulation. The procedure always resulted in exposure of the enamel cavity wall and a clinical situation conducive to the future initiation of caries.

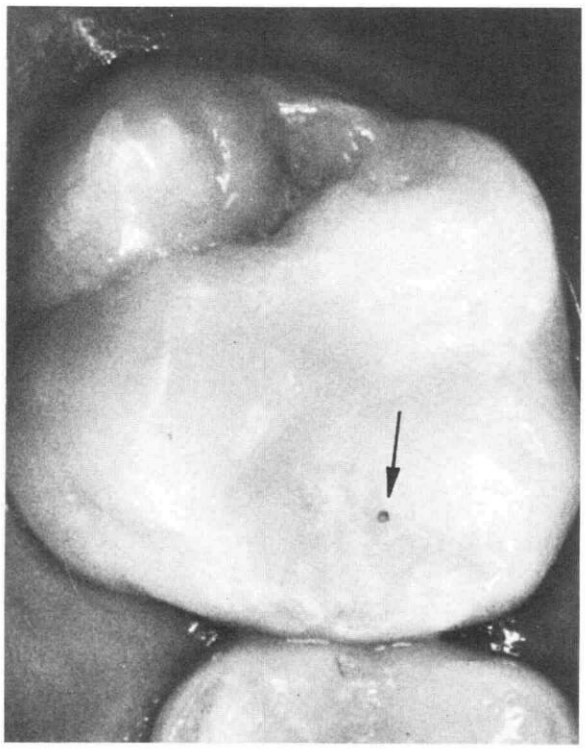


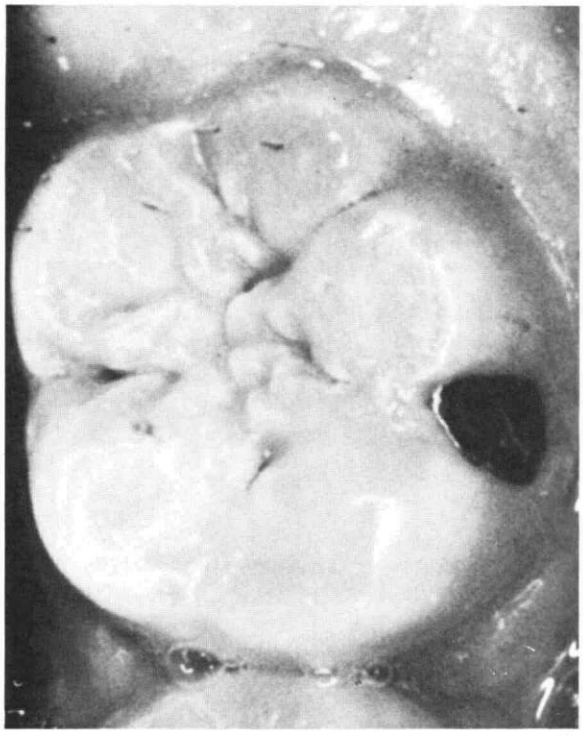
Figure 4. Sealant coating on maxillary first molar, air void present along mesial-buccal groove (arrow) one week after initial application.

By analyzing the time involved in the retreatment procedures (Tables 2 and 3), it is concluded that an average sealant treatment can be maintained for 18 months and involved a little more than half the time (8 min.:45 sec.) that is utilized to place and maintain a Class 1 amalgam restoration (13 min.:58 sec.). However, this does not include the time spent making appointments and preparing for the procedure.

Many of the sealant defects retreated in this study appeared minor and could possibly have been observed for longer periods of time. Further study is necessary to characterize the extent to which the clinical deterioration of sealant can be observed before reapplication is essential. Once caries is initiated, a cavity must be prepared and the removal of tooth tissue is permanent. The succeeding replacement of amalgam restorations also necessitates minimal extension of the cavity preparation with further tooth tissue removal. Proper application of sealant requires the service of the dental profession, with a commitment to time and expense in a mandatory recall program, but with gratifying results in the prevention of oral disease and preservation of sound teeth (Figure 7).

Conclusion

After an 18-month period of study comparing the treatment of pit and fissure surfaces with sealant to contralateral surfaces restored in amalgam, it is obvious that a sound maintenance program with frequent recall evaluations is mandatory for sealant success. It was possible to maintain all sealed teeth in a caries-free state, but at each recall there was a need for retreatment. The greatest need was at the six-month recall and could indicate a potential for early failure due to surface contamination during treatment. Reapplication of the sealant was generally necessitated by the presence of air voids or loss of material in a localized area with exposure of an underlying fissure. Retreatment was successful on all teeth and the bond between materials was not visible clinically. The time required to place and maintain the amalgam was 13 min.:58 sec. whereas the cumulative time invested in the sealant



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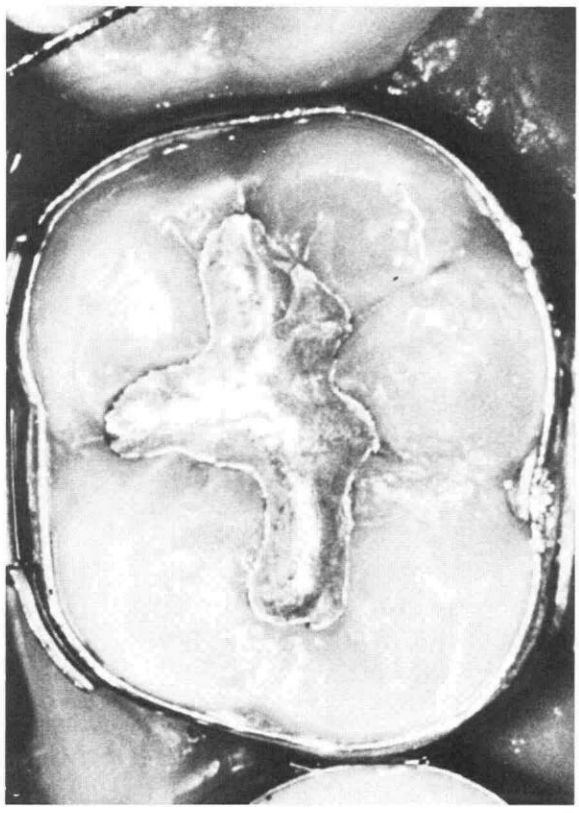
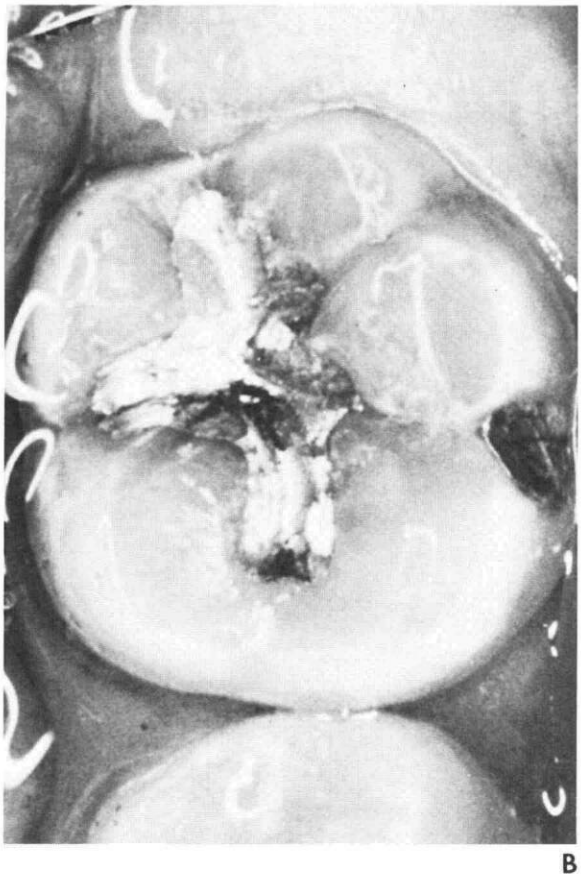


C

Figure 5. Typical amalgam restoration. (A) Preoperative view of occlusal surface; (B) Polished restoration at baseline evluation; and (C) After 18 months.



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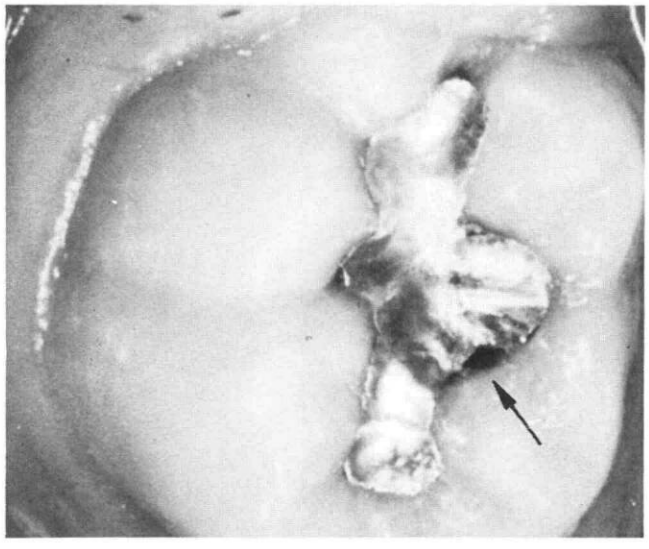

Figure 6. Amalgam restoration, crevice formation along margin after 18 months (arrow).

treatment was significantly lower at 8 min.:45 sec. There appears to be little economic advantage to using sealant to treat pit and fissure defects, therefore the commitment to sealant treatment must be prevention oriented and portend the preservation of sound tooth tissue.

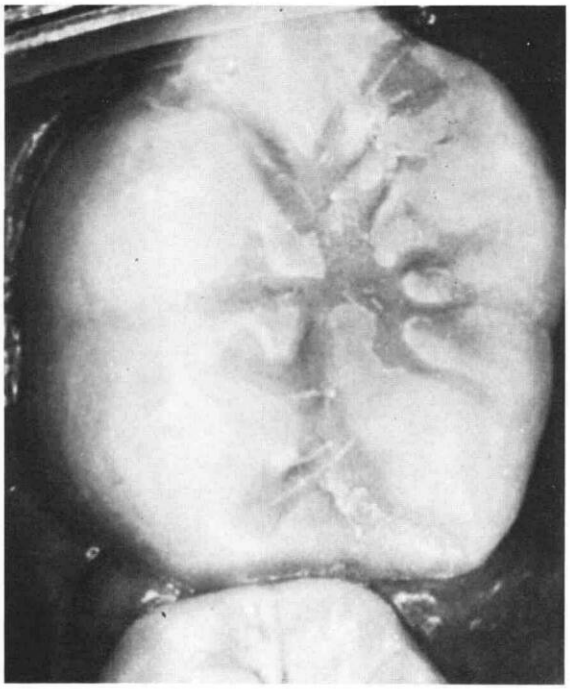

Figure 7. Successful sealant treatment after 18 months.

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