

# The sealant restoration: indications, success and clinical technique

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**In this paper we have considered the available literature which demonstrates that sealant restorations perform at least as well as amalgam restorations and are more conservative. Success depends on retention of the overlying sealant and if this is fully retained it is unlikely that any residual caries will progress. The diagnosis of occlusal caries and indications for sealant restorations are discussed and the clinical technique is described. We have concluded that sealant restorations are the optimum restoration in small and discrete occlusal cavities.**

The sealant restoration is indicated primarily on the occlusal surfaces of permanent molars and premolars and may also be indicated for primary molars. They are most appropriate when the prepared cavity in a pit or fissure is small and discrete. Larger cavities would be more appropriately restored with amalgam or a posterior composite whilst smaller cavities may be restored with sealant alone.

It is difficult to quantify what constitutes a small and discrete cavity but it will be influenced by the occlusal area of the cavity, whether functional cusps are involved and the morphology of the opposing occlusion.

## Diagnosis of occlusal caries

The early diagnosis of occlusal caries represents one of the major challenges for the practising dentist. While cavitated lesions are easily detected clinically, it is lesions that fall between a sound tooth surface and cavitation that are the most difficult to diagnose. Diagnosis may involve the use of visual, tactile and radiographic examination.

Visual examination should be undertaken with the teeth thoroughly air dried

and properly illuminated. The use of magnification may also aid diagnosis. The use of a probe should be restricted to the removal of plaque or food debris. Lesions should not be probed as has been advocated as this may cause cavitation.<sup>1</sup> Drying the tooth significantly improves diagnosis by driving fluid out of the micropores of demineralized enamel, the affected area appearing a matt white in contrast to the gloss of normal enamel.

Dark staining is not a criteria for diagnosis of caries alone, but loss of normal enamel transparency surrounding a pit indicates the presence of demineralization and may indicate a developing lesion.

Bitewing radiographs are a pre-requisite when considering a sealant restoration. These should show no evidence of interproximal caries which may indicate that a more extensive restoration is required. It should be considered that the actual size of the lesion is usually larger than the radiographic image implies.<sup>2</sup> Lesions suitable for sealant restoration placement may be

those just into dentine. Bitewings are of great importance in the diagnosis of occlusal caries particularly with the advent of 'hidden caries' or the 'fluoride syndrome'. This was first described by Millman in the early 1980s and is the term used to describe occlusal dentine caries that is missed on visual examination but detected radiographically or when a fissure biopsy is undertaken.<sup>3</sup> It is thought to be associated with the use of fluoride toothpaste, community fluoridation and topical fluoride therapies. There is still controversy regarding the existence of 'hidden caries' but the general consensus in the literature is that it does exist as an entity.<sup>4</sup>

Fibre-optic transillumination may also be of benefit in diagnosing occlusal and interproximal caries. Continuing developments are being made in the concept of electrical impedance<sup>5</sup> and laser fluorescence (Diagnodent, KaVo) appears to have potential in detecting and monitoring occlusal caries.

## Success rates for sealant restorations

One of the major problems when considering the success rates of sealant restorations is the variation in techniques and materials used. There are also few studies directly comparing sealant restorations with conventional amalgam restorations.

Short term studies indicate a high degree of success for sealant restorations.<sup>6-15</sup> However, longer term studies appear to indicate that success is less predictable (Table 1).<sup>16-21</sup> For direct comparison of sealant restoration studies it is necessary to define success as 100% retention and no caries present in the tooth.

However, presenting the studies in this manner can give a misleading picture and it is necessary to consider a number of the studies in more detail.

Mertz-Fairhurst *et al.*<sup>21</sup> reported 9-year results comparing three types of restoration: unsealed amalgams, amalgams with sealant and composite with sealant. Twenty-eight per cent of the sealants were fully retained in the composite and sealant type, a further

### In brief

This article discusses:

- Indications for sealant restorations
- The diagnosis of occlusal caries
- Clinical procedures for sealant restorations
- Success rates for sealant restorations

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41% were partially retained and only 16% of the sealant restorations failed because of caries. What is particularly interesting is that restorations were placed over carious lesions after minimal preparation and that the carious lesions did not progress beneath intact sealed restorations. The clinical performance of the composite and sealant type was superior to the other restoration types and the authors concluded that 'sealed restorations are superior to traditional amalgam restorations'.

In a noteworthy study Welbury *et al.*<sup>21</sup> compared minimal composite restorations with amalgam restorations over 5 years. While only 26% of the sealant restorations were fully retained and caries free, only 2% of the restorations failed because of caries associated with the restoration. There was no significant difference in median survival time between the amalgam and sealant restorations, and it was found that on average amalgam restorations occupied 25% of the occlusal surface of the tooth, while minimal composite restorations occupied 5%.

Haupt *et al.*<sup>20</sup> in a 9-year study demonstrated that 54% of sealant restorations had completely retained sealants with 25% sustaining partial loss. Occlusal caries was recorded in 25% of restorations in which there was sealant loss but there was no occlusal caries when the sealant was fully retained.

The consensus from the studies is that sealant restorations perform at least as well as conventional amalgams and are far more conservative of tooth tissue. It is also apparent that the longevity of the sealant restoration is dependent on the complete retention of the overlying sealant.

If the overlying sealant is fully retained then recurrent caries or progression of caries beneath the restoration is negligible. This is consistent with studies of caries progression beneath fissure sealants which indicate that it does not progress beneath intact sealants.<sup>22-27</sup>

Consequently if a sealant restoration is placed, the dentist has a duty of care to ensure that the retention of the sealant is regularly reviewed and repaired or replaced as necessary. In addition bitewing radiographs should be taken at appropriate

Study	Duration (years)	Success* (%)
Simonsen and Stallard <sup>6</sup>	1.0	100
Azhadri <i>et al.</i> <sup>7</sup>	1.0	86
Walker <i>et al.</i> <sup>8</sup>	1.25	82
Haupt <i>et al.</i> <sup>9</sup>	1.5	91
Gray <sup>10</sup>	2	67-97
Walls <i>et al.</i> <sup>11</sup>	2.0	97
Simonsen and Jensen <sup>12</sup>	2.5	96
Raadal <sup>13</sup>	2.5	84
Simonsen <sup>14</sup>	3.0	99
Haupt <i>et al.</i> <sup>15</sup>	3.0	77
Haupt <i>et al.</i> <sup>16</sup>	4.0	64
Welbury <i>et al.</i> <sup>17</sup>	5.0	26
Haupt <i>et al.</i> <sup>18</sup>	6.5	65
Simonsen and Landy <sup>19</sup>	7.0	90
Haupt <i>et al.</i> <sup>20</sup>	9.0	54
Merzt-Fairhurst <sup>21</sup>	9.0	28

\* Complete sealant retention and tooth caries free

intervals to check there is no further caries progression.

#### Clinical procedure

It is useful to mark occlusal contacts prior to preparation. This will assist in the final decision as to whether a sealant restoration is appropriate.

If it is anticipated that the cavity may be of moderate size then local anaesthesia will be necessary. Ideally the tooth is isolated with rubber dam (Fig. 1) This not only assists in moisture control but also aids visualisation and cross-infection control.

What has been termed the fissure or enamel biopsy is then undertaken with a small diameter bur such as a tungsten carbide long pear (Jet 330, Beavers Dental). This involves cutting a minimal opening to the depth of the enamel-dentine junction sufficient to determine whether the caries is more widespread (Fig. 2). All suspect areas of the fissure system should be explored.<sup>28</sup> In this case there is dark staining and associated opacity in the central pit of the tooth.

If the carious lesion extends beyond the enamel-dentine junction (Fig. 2) caries removal should be continued, limiting removal to carious tissue only (Fig. 3). Probably the most reliable method of caries assessment remains surface colour, structure and hardness, and the cavity is accordingly assessed.<sup>29</sup>

Where there is restricted access it is important to thoroughly inspect the cavity to ensure that caries removal is complete (Fig. 4). The cavity is then assessed to determine whether a sealant restoration is indicated. More extensive caries may necessitate an amalgam restoration or posterior composite.

Once the restorative has been placed the restoration and remaining fissures can be fissure sealed. This may involve etching of the enamel if this has not already been undertaken as part of the composite bonding procedure.

Finally the rubber dam is removed, occlusal contacts checked and any interferences removed (Fig. 5).



**Fig. 1** Tooth isolated with rubber dam



**Fig. 2** Caries extending beyond the enamel dentine junction



**Fig. 3** Caries removal limited to carious tooth tissue



**Fig. 4** Completed minimal cavity preparation

A number of restorative techniques and materials are available for the restoration of the cavity. At present four types of sealant restoration are available under the NHS GDS fee scale:

1. GDS Item 14e1: Fissure sealant alone
2. GDS Item 14e2: Fissure sealant with composite resin
3. GDS Item 14e3: Fissure sealant with glass ionomer
4. GDS Item 14e4: Fissure sealant with both composite resin and glass ionomer.

If the caries does not extend beyond the level of the enamel dentine junction fissure sealant only may be required. If however the cavity is of a larger size a number of options exist, involving the use of composite resin, glass ionomer or both materials in combination.

The indications for the use of the four



**Fig. 5** Checking occlusion of completed sealant restoration

type of sealant restorations has been summarised by Paterson *et al.* (Table 2).<sup>30</sup>

It is apparent from Table 2 that there are a variety of restoratives available for use in the sealant restoration technique. The exact choice of material may often be a matter of operator preference.

The use of glass ionomer may confer advantages with regard to chemical bonding with enamel and dentine, fluoride release and possible reduction in microleakage.<sup>31–33</sup>

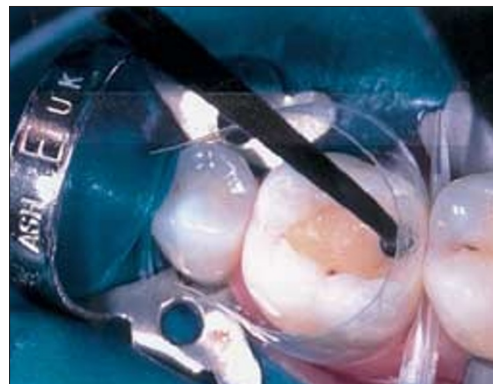
A number of recently introduced materials such as the 'packable' composites (Prodigy, Kerr; Solitaire 2, Heraeus Kulzer; Filtek P60, 3M) are available which may offer easier handling than conventional composites. The authors have also found the use of coated 'non-stick' composite instruments useful for posterior composite placement and adaptation (Fig. 6). These instruments (Ash) are available with a range of tips which facilitate more easy access and packing (Fig. 7).



**Fig. 6** 'Non stick' composite instruments

More recently introduced 'flowable composites' (Revolution, Kerr) may also prove to be beneficial in restoring cavities in which there is restricted access.<sup>34</sup> However physical properties are inferior to conventional composites and they would appear inappropriate for larger posterior cavities or where there are heavy occlusal contacts.

Table 2 Indications for the use of each of the four types of sealant restoration	
Type of sealant restoration	Indications
Type 1 <i>Fissure sealant alone</i>	Stained and decalcified fissure No radiographic sign of dentine involvement Less than two other carious lesions in mouth
Type 2 <i>Composite plus sealant</i>	Stained and decalcified fissure More than two other carious lesions in mouth Enamel biopsy shows lesion confined to enamel
Type 3 <i>Glass-ionomer cement plus sealant</i>	Enamel biopsy indicated Cavity in dentine with minimal lateral spread Margins not in occlusal contact
Type 4 <i>Laminate restoration</i>	Enamel biopsy indicated Lesion in dentine with lateral spread along EDJ Cavity margins in occlusal contact
<i>Amalgam restoration</i>	Enamel biopsy indicated Large radiolucency in dentine Significant lateral spread along EDJ Few fissures remaining surrounding cavity



**Fig. 7** Adaptation of composite in a large posterior cavity

With minimally invasive techniques such as air abrasion and chemomechanical caries removal<sup>35-37</sup> materials such as the flowable composites may allow easier restoration placement where access is restricted.

### Conclusions

Whilst the success of larger posterior composites appears to be inferior to amalgam<sup>38</sup> success rates for sealant restorations are comparable to those of amalgam restorations but with the advantage that they are less invasive and hence sound tooth tissue is not removed.

Dentist concerns regarding the reported success of sealant restorations appear to be largely unsupported by longevity studies. Possible fears over incomplete caries removal also appear to be unwarranted, with caries appearing not to progress beneath intact sealants. Potential problems regarding the marginal shrinkage of composites and recurrent caries may be addressed by using glass ionomer in the technique. The cost-effectiveness of the procedure may be influenced by the re-introduction of a fee-for-service element into the capitation payment system for children's dentistry.

The use of the sealant restoration should be encouraged because it represents a tooth preserving procedure, producing a more durable restoration with the added benefit of protecting the remaining fissure pattern from carious attack. It may have the potential to improve the prognosis of a tooth in 'the repeat restoration cycle'.<sup>39</sup> It is apparent however that the dentist has a duty of care to ensure that the sealant restoration is regularly reviewed and maintained to ensure continued success.

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