

Clinical guidance and an evidence-based approach for restoration of the worn dentition by direct composite resin

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Key points

Reviews bonding agents and composite properties regarding which materials are better suited for restoration of the worn dentition.

Discusses the clinical steps and techniques, based on current evidence, required to restore worn teeth with direct composite resin.

Illustrates the application of direct composite from relatively moderate wear to severe wear seen in older patients.

This paper aims to provide the dentist with practical guidance on the technique for direct composite restoration of worn teeth. It is based on current evidence and includes practical advice regarding type of composite, enamel and dentine preparation, dentine bonding and stent design. The application of direct composite has the advantage of being additive, conserving as much of the remaining worn tooth as possible, ease of placement and adjustment, low maintenance and reversibility. A pragmatic approach to management is advocated, particularly as many of the cases are older patients with advanced wear. Several cases restored by direct composite build-ups illustrate what can be achieved. The restoration of the worn dentition may be challenging for many dentists. Careful planning and simple treatment strategies, however, can prove to be highly effective and rewarding. By keeping any intervention as simple as possible, problems with high maintenance are avoided and management of future failure is made easier. An additive rather than a subtractive treatment approach is more intuitive for worn down teeth. Traditional approaches of full-mouth rehabilitation with indirect cast or milled restorations may still have their place but complex treatment modalities will inevitably be more time consuming, more costly, possibly require specialist care and still have an unpredictable outcome. Composite resin restorations are a universal restorative material familiar to dentists from early-on in the undergraduate curriculum. This review paper discusses the application of composite to restore the worn dentition.

The material

The basic composition of dental composite has not changed since the 1970s with inorganic filler particles embedded in a resin matrix. The two phases being coupled or bonded together by a silane coupling agent. There has been, however, significant development of resin technology, filler type, filler particle size and its loading.

Polymerisation shrinkage is inversely proportional to filler loading. Hybrid composites have a range of filler sizes with sub-micron particles

(microfine 0.04–0.2 μm) giving wear resistance and reduced shrinkage stress whereas the larger fillers of up to 1.0 μm provide increased strength and reduced expansion/contraction.¹ Total filler content is higher than microfilled composites with between 75–80% filler by weight. Hybrid composites have the advantage that the dispersed submicron particles prevent crack propagation by stress transfer between the particles rather than through the resin matrix.¹ Microfilled composites by comparison have the lowest filler by loading and are highly polishable but because the proportion of resin is higher they have greater thermal expansion, greater water sorption and lower hardness than hybrids.¹ A harder composite is particularly important when restoring natural tooth substance worn away by attrition. This is a relatively simplistic approach to the wear of composite which will undergo cyclic fatigue wear, corrosive and hydrolytic wear, as well as both 2-body and 3-body abrasion.² Even so,

hybrid composites (50–60 KHN) are slightly softer than dentine (68 KHN) and much softer than enamel (343 KHN) and so will preferentially wear away when occluding against tooth substance.³ The composite is thus sacrificed in order to protect remaining tooth tissue particularly if the high occlusal/incisal loads that occur in bruxism continue.

Furthermore, light-curing technology has also changed from traditional quartz halogen to blue-LED, argon laser and plasma (xenon) arc lamp light curing. An increase in the depth of cure has thus been achieved by a reduction in filler content, an increase in particle size, incorporation of additional photo-initiators and by an increase in light intensity.²

The type of composite used will depend on personal preference but the dentist should appreciate the differences in composition and physical properties. Composite was originally developed as an aesthetic material to replace the inferior silicate anterior restoration.

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Improvements have led to its application posteriorly and indeed as a replacement for dental amalgam. Its specific use for the restoration of tooth wear was not envisioned but several studies have reported that dental composite is a suitable material to restore worn teeth (see below). In bruxists, the restoration of anterior guidance using a Dahl approach is perhaps one of the most challenging restorative scenarios dentists have to face. A hybrid composite is therefore recommended for the restoration of tooth wear.

Bonding

Enamel bonding

The ability to bond to tooth structure has been one of the major developments in dentistry. Etching enamel results in increased surface area and microporosities for subsequent resin infiltration and micromechanical retention. The Type I etch pattern is ideal whereby intraprismatic enamel is removed rather than interprismatic enamel (Type II etch pattern) or a combination of patterns (Type III).^{1,2} Prism orientation has a profound effect on enamel tensile strength.^{4,5} Enamel stressed parallel to prism orientation is stronger than enamel stressed perpendicularly and by extension, composite bonded parallel to prism orientation results in higher microtensile bond strengths (μ TBS) compared to bonding perpendicular to enamel prisms.^{6,7} Etching prisms 'end-on' followed by thorough rinsing before applying the bonding resin results in the penetration of the resin. Lower viscosity and lower surface tension adhesives with low contact angles favour wetting and penetration.^{1,2} Separate etch and wash followed by resin infiltration rather than use of self-etch resins with a single step have better overall performance.

Dentine bonding

Bonding to dentine presents a bigger challenge because of its heterogenous composition with greater water and organic content compared to enamel. Dentine bonding has developed over several generations culminating in the self-etch systems. Dentine bonding involves three stages: conditioning (in effect acid etching), priming and bonding.

The conditioning first step either removes or modifies the smear layer. Systems that involve etching enamel and dentine simultaneously followed by a post-conditioning rinse remove the smear layer and are commonly referred to as 'etch and rinse' or 'total etch'. Whereas

'self-etch' systems incorporate both a primer and an acid. The pH of the incorporated acid is in the range 2–2.5 which is much weaker than phosphoric acid etchant with pH 0.5. Enamel margin integrity with the self-etch systems is inferior and this in turn has led to so-called selective etching of enamel. It is generally believed that a separate etch followed by prime and bonding or 'total etch' is the gold standard.⁸

The primers are bifunctional molecules that act as the adhesive between hydrophilic dentine and hydrophobic composite. Common primers include HEMA, 4-META, GLUMA, PMDM and 10MDP.¹ Self-etch primers are not rinsed as they modify the smear layer and incorporate it within the hybrid zone which means the dentine remains moist. The primer is carried in a solvent such as ethanol or acetone, whose role is to displace the water in the dentine and so pull the adhesive into the surface. The demineralised dentinal collagen should be moist to allow primer infiltration otherwise excessive drying, or worse, desiccation of the dentine surface results in the collapse of the collagen onto the mineralised surface preventing formation of the hybrid layer. So-called wet bonding, however, may not be feasible on worn tooth surfaces as the dentine is sclerotic or hyper-mineralised. Peritubular or intratubular dentine has smaller hydroxyapatite crystals and is five times harder than intertubular dentine.⁹ Significantly weaker bond strengths were reported to hypermineralised dentine than normal dentine and scanning electron micrographs showed occluded tubules, thin resin tags and no hybrid layer.¹⁰ Thus micromechanical and chemical changes in sclerotic exposed dentine may impact unfavourably on dentine bonding. A recent systematic review concluded that the best performing adhesives were three-step etch and rinse and that self-etch resins were prone to water degradation.¹¹

In summary, a separate etch and rinse for both enamel and dentine followed by placement of a hybrid direct composite is the recommended material for worn teeth.

Preparation

It is possible that many dentists are unaware of another recommendation to roughen the dentine surface before bonding which may be particularly important on worn dentine.^{12,13} Before this is discussed, mention needs to be made of enamel margin preparation. Etched prismless enamel had less porosity and poorer resin penetration than prismatic enamel in deciduous teeth.¹⁴ Similarly, therefore, it is advisable to bevel margins on aprismatic enamel in young adult patients. This has the advantage of removal of any prismless enamel and the exposure of the ends of prisms in prismatic enamel as discussed previously. Beveling also improves marginal shade match by graduation of the composite thickness. The method of enamel margin preparation will also influence the nature of the bond since diamond burs will grind the enamel resulting in a thicker smear layer while tungsten carbide flutes will cut the surface resulting in a cleaner, less smeared surface for etching (Fig. 1a).¹⁵

Five pre-etch dentine surface roughening techniques were compared after bonding composite with either etch and rinse adhesive (OptiBond FL, Kerr, USA) or mild self-etch resin (Clearfil SE, Kuraray, Japan) on normal dentine and eroded dentine surfaces.¹³ The micro-tensile bond strengths were generally lower on eroded dentine compared to non-eroded dentine but the authors concluded that minimal roughening with a diamond bur is highly recommended. It is the minimal roughening that is important rather than the type of bur as this author uses a slow speed stainless steel round bur which has the advantage of greater control compared to a

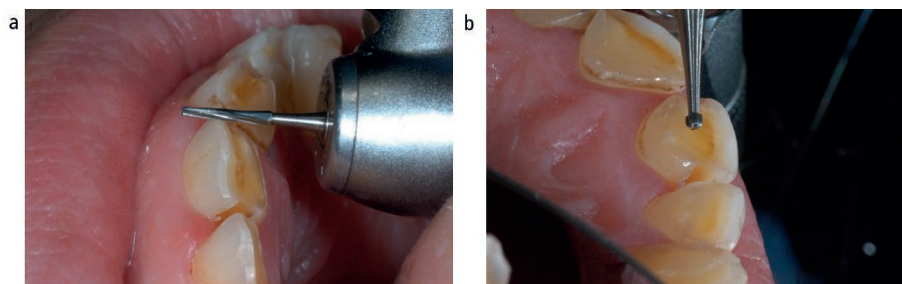


Fig. 1 The enamel bevel cut by a fluted tungsten carbide bur and the use of a stainless steel round bur to roughen the dentine before etching both surfaces

Box 1 Steps in the initial management and planning for composite build-ups

- Examine & record the extent & severity of tooth wear. Use indices for example, BEWE, TWI
- Identify risk factors
- Give appropriate advice/counselling
- Monitor if appropriate. Use baseline record such as casts, images, silicone putty indices
- Review after 1 year with baseline record. Check compliance with advice
- If patient requests restoration without a monitoring period, agree to treat but caution patient regarding greater possibility of failure
- Take study casts for diagnostic wax-up and laboratory made stent/matrix if indicated
- Certain stent/matrix materials can be made directly onto the wax-up, for example, Memosil or Zhermack Elite Glass (addition cured silicone) but others require vacuum forming on a stone duplicate for example, Copyplast (Polypropylene blanks from Scheu Dental, Iserlohn 58,642, Germany)
- Take facebow record and RCP record especially if increasing OVD although evidence for this is lacking. An ICP record in cases where the OVD is to be increased on anterior teeth by a Dahl approach often suffices. In many older subjects with a lack of posterior support/missing molars, eruption is not possible. The occlusal approach is conformative if working within the existing OVD but not truly re-organised if increasing it with a Dahl approach
- The laboratory prescription should indicate where the wax needs to extend and which areas require build-up. Technicians tend to wax-up lost areas or more accurately lost volume but as discussed the clinician may want to bond onto sound enamel for example, labially. This needs to be indicated on the lab card
- Wax-up of the incisal edges may need to be fairly wide in order to provide flat anterior guidance so that the composite is under compression rather than tension. This is probably more important in Dahl restorations when loading is on the anterior composite build-ups

high speed diamond bur especially if working near the pulp (see Figure 1b). Furthermore, the salivary pellicle is resistant to acid removal and running a bur lightly over the dentine surface will at least partly remove the pellicle which is a tenacious glycoprotein biofilm between 10 µm and 100 µm thick.^{16,17} Removal of the pellicle, which has a very low surface energy (28 mJ/m²), will also improve wetting by the adhesive.² Interestingly, the thickness of the acquired pellicle has been shown to determine site specificity of erosion such that thinner pellicle is present on palatal surfaces of the maxillary anterior teeth.¹⁸

Application of composite build-ups

The initial step for any tooth wear case is to identify and control the risk factors, which requires in depth and sensitive questioning of the patient. In an ideal world, restorative treatment should be postponed until the dentist has established that the wear is not progressing and that the patient has been compliant with advice. In the real world, this is not always possible nor indeed is it desirable. A pragmatic approach should be adopted to manage the patient's concerns. An example would be a patient with bulimia nervosa or an adolescent who has eroded teeth and seeks treatment. Any patient, but particularly a vulnerable one, must be managed sympathetically and with empathy.

A recent European consensus on the management of severe tooth wear highlighted a conservative, minimally invasive approach.¹⁹ It further stated that an additive approach entailed the selection and appropriate application of adhesive techniques to be critical for successful restoration of severe tooth

wear. The publication of this document has probably resulted from increased evidence of good clinical performance and survival of dental composite in this clinical situation. An additive approach plans to preserve as much, if not all, remaining tooth structure whereas a subtractive approach implies removal of tooth resulting in even less area for bonding of already compromised teeth. Restoring with direct composite is a reversible and conservative strategy that has much to commend it. Composite can be adjusted and drilled away which is what is meant by reversibility, although the resin bonded/infiltrated substrate should be left. Determining the depth of composite and the interface location can be difficult especially when the shade match is excellent.

Several publications have reported on the application, survival, failure and performance of composite restorations or build-ups for worn teeth.^{20–32} The aim of this paper is not to review the results in any detail but to inform the reader of the supporting evidence for the conservative, minimally-invasive approach. A recent systematic review of only six studies determined that a meta-analysis on the survival rates of anterior composites was not possible because of the considerable heterogeneity in study design, follow-up periods, and a lack of a clear definition as to what constituted anterior composite failure.³³ Nonetheless, recent studies have reported survival rates for direct composite restorations of between 50% and 95% up to ten years. A large case series of over 1,000 direct composites in 164 patients found older patients presenting for treatment tended to be males with more advanced tooth wear than females and consequently less tooth

substance was available for composite restoration. Time to failure was lower in older patients and significantly more failures occurred when a lack of posterior support was present but only 7% of the direct composites failed up to 8 years follow-up.³⁰ Other recent studies have reported 89% and 83% success rates with composite.^{31,32}

The techniques for direct composite placement vary and depend on patient factors for example, space, amount and location of wear and dentist factors for example, experience. Dentists must determine whether or not there is space for restoration and record whether or not an increase in the occlusal vertical dimension (OVD) is required. This is particularly relevant for palatal or occlusal wear cases.

There are, therefore, two very important steps when planning treatment:

- Check ICP/CO and RCP/CR (intercuspal position/centric occlusion and retruded contact position/centric relation)
- Check free-way space (FWS) or inter-occlusal space.

Once closed in ICP, the dentist can see how much space, if any, is available. With the mandible further back in RCP there may be some space for placement of palatal anterior composites. As wear proceeds, any loss of occlusal vertical dimension (OVD) can be balanced by dento-alveolar compensation. Why some cases have compensation and others do not is unclear but working within the existing vertical dimension may be a comfort to the dentist and patient. Studies have not found, however, any deleterious effects of increasing the OVD.^{34–36} Clinical classifications and indices of anterior and general wear

Box 2 Clinical steps for provision of composite build-ups using a matrix/stent

- Bevel enamel margins (fluted TC bur) and lightly roughen exposed dentine (slow speed round bur)
- Wash and dry
- Total etch enamel and dentine for 30 seconds
- Wash and dry
- Use strip of PTFE tape as interdental separator either side of tooth to be built up
- Apply bonding resin and cure
- Syringe composite into worn surface and into the stent. An excess is needed but not too much
- Seat stent with gentle but firm pressure making sure it is fully seated
- Light cure built-up surfaces through stent, usually the labial and palatal
- Remove stent and repeat previous step to make sure composite is fully cured
- Remove PTFE tape by gently pulling labially. If stuck, proceed to next step
- Removal of excess composite at gingival margins with narrow & ultra fine diamond finishing burs
- Continue to build-up each tooth in turn
- Shaping should be minimal as stent provides overall contours
- Final trimming. Check for any remaining flash especially gingivally. Use interdental abrasive strips
- Polish with abrasive discs taking care not to remove any micro-anatomy
- Patient should see the final result & be reassured that adaptation is typically quick
- Review after a few weeks for any final adjustment and possible provision of bilaminar guard

have been developed, which can aid dentists in deciding when and how to restore.³⁷⁻³⁹ Patients generally attend, however, once aesthetics are compromised.⁴⁰

The approach to management of wear may be dictated by its position in the arch and whether it is anterior or posterior, localised or generalised.⁴¹ The following sections will focus on technique rather than treatment concepts.

Direct composite placement

As discussed previously, any technique should be standardised and Box 1 outlines the initial steps to manage the worn dentition. There are three techniques that can be used for direct composite application:

- Freehand
- Palatal matrix made from silicone (polyvinylsiloxane, PVS) on cast with diagnostic wax-up
- Full coverage stent/matrix made from chemical/light cured material on cast with

the diagnostic wax-up or vacuum formed on a duplicate cast of the diagnostic wax-up.

The use of stents/matrices depends to some degree on the aetiology of the wear. On anterior teeth, erosion will typically result in more palatal surface loss whereas attrition will result in loss of coronal structure in a more horizontal manner. There are no hard and fast rules on how to tackle either situation, nor on what is the minimum amount of tooth structure that can be built up. Even cases that have lost 75% of coronal structure can be successfully built up with direct composite.⁴² There are variations on the theme of stent application with palatal wear being restored before inciso-labial build-up or in cases with mostly intact palatal surfaces having the palatal matrix placed intra-orally and the incisal height built up. Many of the cases treated by the author have severe wear and had a full diagnostic wax-up followed by stent manufacture and, in effect, full coronal composite build-ups. Conventional treatment

in the form of crowns were not possible due to the lack of tooth substance and direct composite adheres to the European consensus for an additive approach.

The clinical steps are listed in Box 2. The application of vacuum-formed templates or clear stents is not new and has been described in the dental literature.^{27,41-44} Close liaison with the laboratory technician is vital so that the wax-up fulfils the desired contours and covers the planned area of the tooth needed for bonding composite. Many cases of anterior tooth wear develop into an edge-to-edge incisal relationship or pseudo class III as a result of mandibular forward posture or compensatory eruption, in which case the composite build-ups should have wide flat incisal surfaces and not thin edges or at the very least shallow guidance, in order to reduce off-axial forces and optimise composite survival by compressive loading as opposed to shear loads.⁴⁵ Another consideration is the depth of cure for composite. Since the stent technique described here relies on full wax-up of most of the crown, technicians should be informed that the thickness of wax should not exceed 3.0 mm.² Several factors affect light curing depth including darker shades, poor technique and quality of light source but the technique adopted here is for all built-up surfaces to be cured initially through the matrix for 20 seconds and after removal of the matrix for a further 40 seconds per surface. Unless a layering technique is used with a palatal matrix, composite build-ups in a stent are bulk-filled restorations requiring attention to stent design, which is often overlooked. The diagnostic wax-up can be shown to the patient. The inclusion of patients in treatment planning and explanation regarding steps in the treatment is part of the informed consent process and should improve the outcome.

For small to moderate areas of wear, direct composite placed free hand is straightforward and can provide an immediate functional and aesthetic benefit. In all the following cases, dental dam was not used, each tooth was built up in turn and every case was treated by the author with one nano-particle hybrid composite (Spectrum, Denstply, Weybridge, UK). The conventional use of dental dam will achieve optimal moisture control and should be used if possible. Stent placement, however, is hindered by it and providing the dentist takes care and focuses on the restoration of a tooth at a time, adequate moisture control in the upper anterior sextant can be achieved

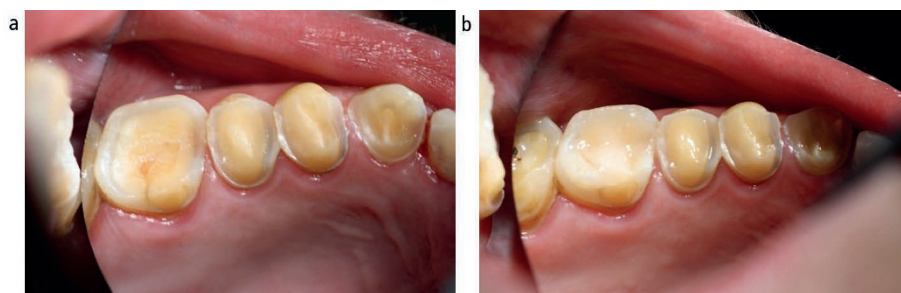


Fig. 2 Case 1 showing the maxillary right first molar pre- and post-composite placement occlusally. The existing OVD was maintained

with cotton wool rolls and, additionally, one of the many commercially available lip and cheek retractors, for example, OptraGate (Ivoclar Vivadent, Schaan, Liechtenstein). Whenever dentine was exposed a total etch technique was employed using Prime and Bond NT (Dentsply, Weybridge, UK). The viscosity of Spectrum is ideal to syringe into worn surfaces and into stents where necessary.

The maxillary first molars and premolars shown in Figures 2a and 2b were very eroded. The first molar had composite added to the occlusal surface as per standard procedure (Fig. 2b). Breaking contact points is advantageous in order to facilitate placement of the matrix band, should one be necessary. This will also prevent preparation margins abutting the adjacent tooth resulting in ease of finishing enamel margins, removal of unsupported enamel and improved marginal seal. Even if occlusal space is limited, composite can be adjusted to harmonise to the existing occlusion in ICP. Cases 2 and 3 (Figs 3 and 4) show erosion of posterior teeth has led to exposed buccal and occlusal dentine. The risk factors were not identified but treatment was provided. Clear buccal matrices can be used to aid contouring of these surfaces but packing with non-stick composite instruments is sufficient followed by curing, contouring with high speed white stones and polishing with abrasive discs such as Shofu Rainbow Super-Snap (Shofu UK, Tonbridge, Kent TN9 1EP). Case 4 (Fig. 5), a Class III, illustrates the clinical problem with no space in ICP. The patient was keen to improve the appearance and direct composites were placed on all the upper anterior teeth except for the crowned 12, 13. An increase in OVD was inevitable but the patient had no adverse effects and function did not change. Of note is the lack of posterior support and as in many cases, the patient, a male, did not have partial dentures. There is no good evidence stating that the OVD should be increased with removable appliances before composite build-ups in order to give the patient a period of adaptation to the new OVD. Many patients are older and attend with many missing teeth including Kennedy Class I in both arches, yet have no functional problems. The driver for treatment is the poor appearance and the imperative for treatment is the tooth wear. Older patients may have reduced adaptive capacity and be disinclined to wearing dentures when they have managed for many years without them. Prevailing pragmatism is to restore and monitor with the caveat that should the composites fail, dentures may be necessary.

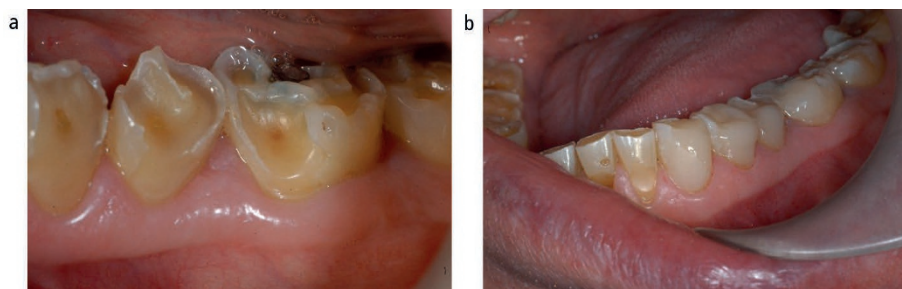


Fig. 3 (a) Case 2 showing marked tooth wear in the lower left quadrant, probably acid erosion, but the aetiology was not identified in this 55-year-old male. (b) The appearance after direct composites were placed on the buccal and occlusal surfaces of the 33, 34, 35, 36, all within the existing OVD

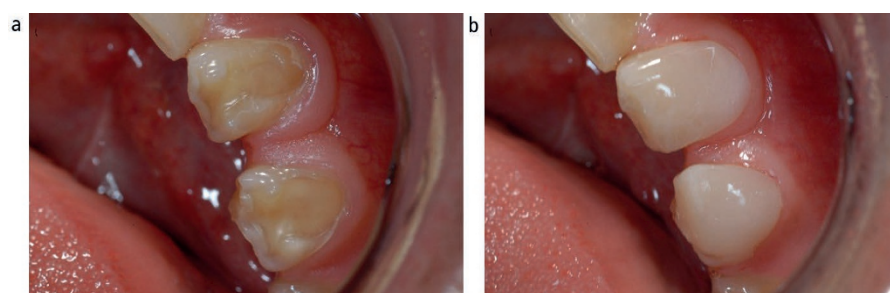


Fig. 4 Case 3 shows buccal erosion on the lower right canine and first premolar in a 23-year-old female. Note the enamel rim at the margins which should be kept to improve marginal seal. Free hand direct composite resin was bonded and packed using non-stick instruments such as non-stick Zirconium Nitride ZNR tipped pluggers and shaping instruments (Dentsply Ash) and OptraSculpt pad (Ivoclar Vivadent, Schaan, Liechtenstein)



Fig. 5 Case 4 illustrates a reverse overjet with an edge-to-edge incisal relationship, lack of posterior support and wear present incisally and labially in a 67-year-old male. The composites were bonded free-hand into the incisal grooves and metal matrix strips cut into short lengths inserted through the inter-dental contacts to prevent the composite from sticking to adjacent teeth. The OVD increase should ideally be followed by provision of dentures at the new OVD but many older patients decline despite advice

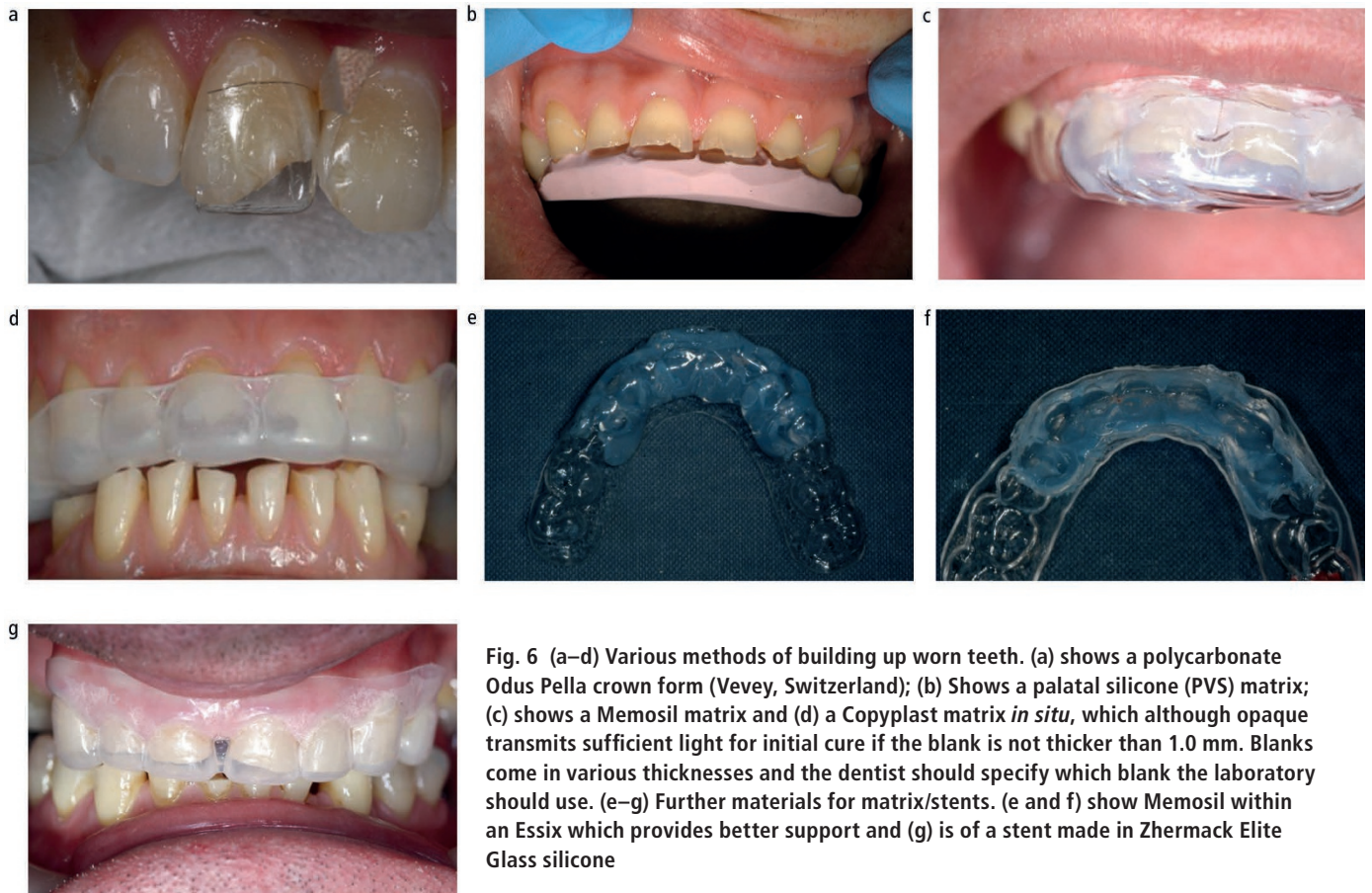


Fig. 6 (a–d) Various methods of building up worn teeth. (a) shows a polycarbonate Odus Pella crown form (Vevey, Switzerland); (b) Shows a palatal silicone (PVS) matrix; (c) shows a Memosil matrix and (d) a Copyplast matrix *in situ*, which although opaque transmits sufficient light for initial cure if the blank is not thicker than 1.0 mm. Blanks come in various thicknesses and the dentist should specify which blank the laboratory should use. (e–g) Further materials for matrix/stents. (e and f) show Memosil within an Essix which provides better support and (g) is of a stent made in Zhermack Elite Glass silicone



Fig. 7 Case 5 shows a typical erosion case with the incisal edge curve and loss of labial enamel. Crown formers (Odus Pella) were used for the central incisor composites. Polishing the gingival margins with ultrafine and narrow diamond burs will lead to some gingival bleeding but it is vital to have smooth margins

Cases 5 to 9 were managed with the aid of a crown form or a matrix/stent. Figure 6a to 6g shows various types of stent or matrix in different materials. Cases 5–9 are shown in

Figs 7–11. The decision to use a crown form or matrix depends on clinical skill, experience and severity of wear. Generally, the more severe the wear the greater the need for

a laboratory wax-up and stent. This has the advantage of planning the case and determining the size and shape of the build-ups. The patient should be involved in this planning phase and appreciate the difficulties and limitations faced by the dentist. Informing the patient that they are unlikely to get teeth that are the same size and shape as their unworn predecessors will go a long way to achieving realistic expectations. Advice or information sheets for patients receiving composite resin can be readily produced within general dental practice and may prove invaluable.⁴⁶

To prevent the composite sticking to adjacent teeth, PTFE tape or plumber's tape is placed across the adjacent teeth. The stent with the loaded composite is placed over the tooth to be built up and seated. The PTFE tape does not interfere with seating as it is very thin (30–120 μm).⁴⁷ PTFE is hydrophobic and has a very low coefficient of friction so is relatively easily pulled through after the composite is cured, although it can be caught up in the proximal excess flash. The author found that the thinner gauge tape on a white reel needs to be doubled up. The ultra-fine narrow diamonds used by the author are shown in Figure 12a and the problem when excess composite or flash

is stuck in the embrasure space is apparent in Figure 12b. Removal of flash and inter-dental polishing with finishing strips can be time consuming. Figure 13 shows PTFE placed on teeth adjacent to the one about to have composite added. Cutting metal matrix bands into short strips which are then placed between teeth is another method of isolating the tooth before build-up (Fig. 14). A diagnostic-wax-up is shown in Figure 15.

As previously stated, in cases where the causal factors continue, in particular bruxism, direct composite is sacrificed to protect the tooth surface. Fitting a lower bilaminar or dual laminate guard is optional in order to protect the composite and increase its survival, although there is only limited evidence for its effectiveness.⁴⁸ Traditional hard occlusal stabilisation splints are indicated for the

management of TMD and by their very nature of being hard may not necessarily protect composite.

In summary

Direct composite restoration of the worn dentition has many advantages over a conventional, older approach using indirect PFM or all ceramic crowns and for localised anterior wear palatal gold or palatal ceramic with or without orthodontics.^{37,49-52} An additive approach conserves remaining tooth which often is unable to provide adequate retention and resistance form for conventional crowns. Dentists need to know which composites to use and how best to optimise survival and performance in a challenging oral environment with persistent attrition, erosion and abrasion.

The application of composite is not new and Poyser *et al.*⁵³ highlighted the low biologic cost and the avoidance of performing destructive restorative procedures on compromised teeth in 2005. A pragmatic approach to restoration has merit, particularly in older patients, who may have reduced adaptive capacity within the stomato-gnathic system, not to mention reduced visual acuity and manual dexterity. The changing age demographic was highlighted in the UK 2011 census. As the large proportion of 'baby boomers,' aged 40–50 years in 2011 get older, there will be more tooth wear and greater demand on the NHS. Direct composite restoration will meet patients' expectations for improved appearance of a disordered, worn dentition and precisely because it is not complex and is relatively low maintenance it will be more acceptable and successful than traditional methods of restoration.



Fig. 8 Case 6 show a multi-factorial wear case with attrition and erosion. Plaque control in this 41-year-old male was sub-optimal. Nonetheless the composites improved his appearance and hopefully motivated the patient to comply with oral hygiene advice

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Fig. 9 Case 7 shows the problem with different degrees of wear on individual teeth in a 43-year-old male. The upper left lateral incisor is very short and the opposing tooth (33) has erupted to maintain contact. Minor reduction of the opposing canine tip (approx. 1 mm) was needed to allow addition of composite to the lateral incisor and generation of an even incisal plane. Lengthening the crowns with composite without taking the composite labially toward the gingival margin may result in a visible margin between enamel and composite. To overcome this problem, composite can be bonded to the labial surface, see case 9

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Fig. 10 Case 8 is of an 89-year-old male who never wore dentures but functioned well despite the lack of teeth and severe upper anterior wear. He had some carious lesions and the labial surface of the upper right central incisor may have sheared off, but the remaining anterior teeth were relatively sound. Direct composites using crown formers and a free-hand technique provided the gentleman with a quick and highly effective improvement in appearance. Advice to wear removable appliances in order to protect the composites was not heeded but he attended a year later without any mishap to the build-ups. Note that the restored incisal relationship was edge-to-edge with every effort made to have even incisal contacts at an increased OVD



Fig. 11 Case 9 shows the upper anterior eroded dentition of a female. She drank significant quantities of fruit juice believing that this was healthy. Again note the lack of posterior support and the very thin central incisors with just the labial surface present. Composite was bonded using a matrix/stent made in Zhermack Elite Glass made on a diagnostic wax-up. Rather than just replace the missing volume of tooth substance, the composite was also added to the labial surfaces thus acting as a ferrule around the remaining tooth substance and gaining retention from the bond to the labial enamel and strengthening the coronal build-up

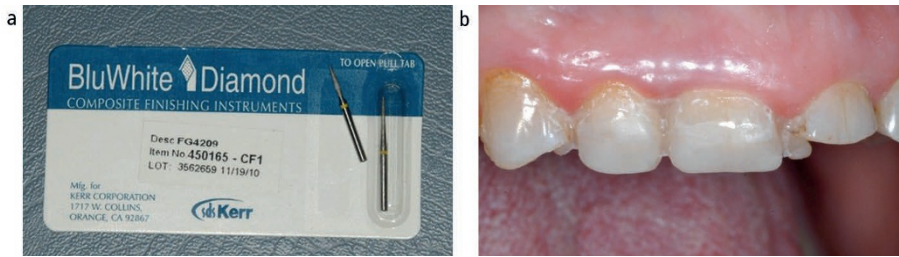


Fig. 12 Ultrafine diamond finishing burs and the problem if insufficient care is taken with prevention of composite 'bridging' across the interdental embrasure. It is time consuming to remove this excess resin



Fig. 14 Metal matrix band cut into short strips and placed through the contacts are rigid enough to be pushed through, particularly if contacts are tight. Note that the adjacent teeth have already been restored with direct composite within the existing OVD. The cupped or grooved incisal edges have been filled to the rim of the cup



Fig. 13 The placement of PTFE tape over adjacent teeth before seating the stent

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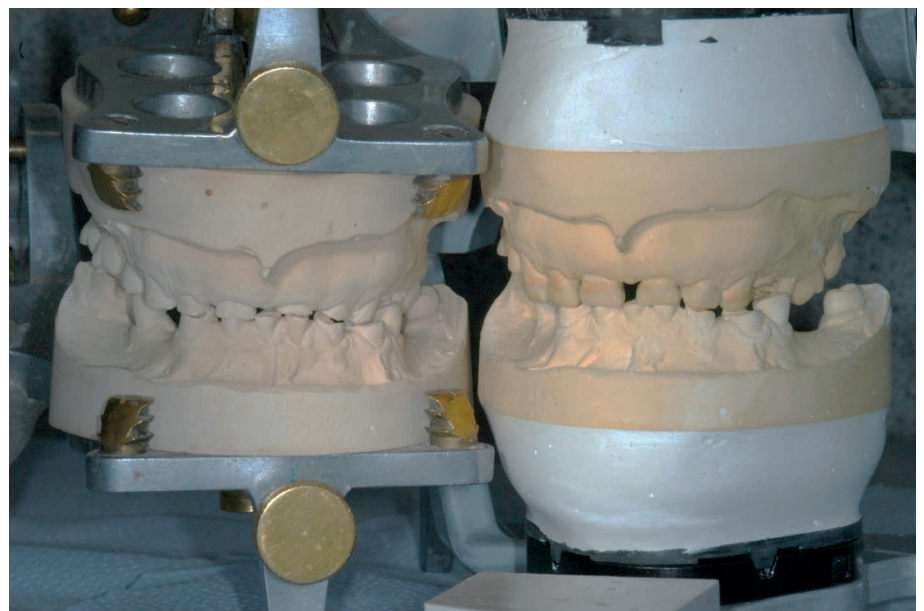


Fig. 15 Stone casts showing pre-wax up worn teeth, related in ICP, and on the right the laboratory wax-up with a Dahl approach at increased OVD. The wax-up ideally should be planned on a semi-adjustable articulator with opening on the retruded arc of closure or terminal hinge axis which requires an RCP occlusal record. In practice, flat incisal guidance allows movement between RCP and ICP (freedom in centric) and adaptation to the new maxillary-mandibular relationship especially if a Dahl approach is provided. In such cases an RCP record may be less critical

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