Evolving conservative dentistry

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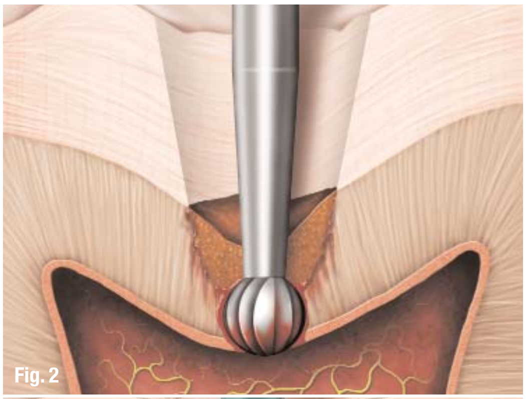
Fig. 1

_A mere 20 years ago, fourth-generation adhesives revolutionised restorative dentistry by offering a predictable technique for bonding to both enamel and dentine.[1] Less than five years later, advances in ionomer and resin technologies provided clinically successful dentine and enamel replacement. In 2003, the first selective preparation burs able to differentiate between healthy and unhealthy dentine were introduced.[2] These were all revolutionary innovations that altered the practice of dentistry significantly. Within a decade, adhesive resin and composites had displaced amalgam as *the* mainstream restorative materials.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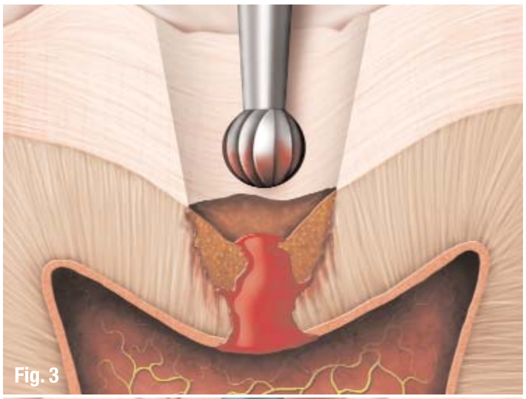
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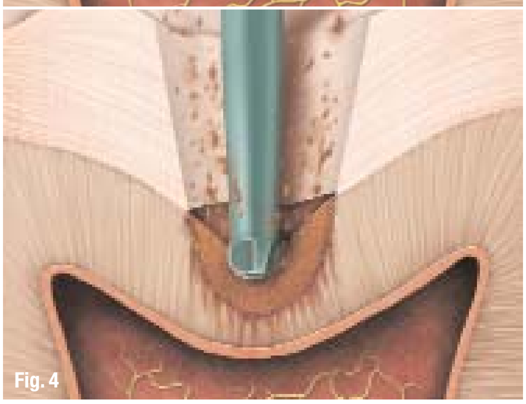
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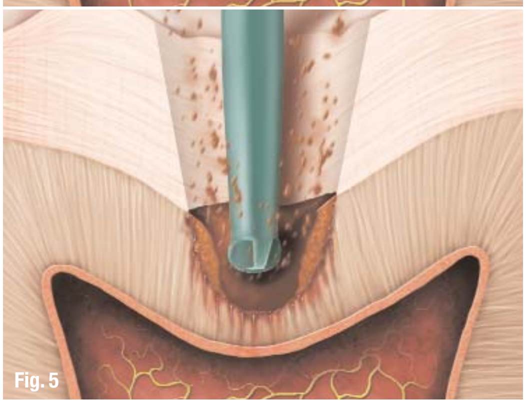


Fig. 5

The intervening years have seen the development of improved fifth- and seventh-generation adhesives,[3,4] micro-hybrid and nano-hybrid composites, LED curing lights, soft-tissue lasers,[5–7] and a host of other adjunct technologies that make dental treatment better, easier, faster[8] and more predictable.[9,10] These innovations have been evolutionary, rather than revolutionary, building upon the existing science through gradual improvement and facilitation.

The three major clinical concerns encountered by practitioners in recent years have included:

_the end-point of cavity preparation (how to differentiate between infected and affected dentine and how much tooth structure to remove to ensure long-term operative success);[11–13]
_the disinfection of the prepared dentinal tissue (how to eliminate the remaining bacteria to prevent re-decay);[14,15] and
_the facilitation and simplification of the restorative protocol (how to reduce the numerous steps and technique sensitivities that arise in the restoration of function and form).

Recent technological advances have done much to allay these concerns and to move dental practice towards ever greater clinical predictability.

_Preparation end-point

Second-generation SmartBurs II (SS White) are self-limiting polymer burs developed to address the clinical problem of the preparation end-point: the removal of *infected*


Fig. 6


Fig. 7

dentine (softened tooth structure that cannot be remineralised)[16] and the preservation of *affected* dentine (infected tooth structure that can be healed and remineralised; Fig. 1). The slow-speed Smart-Burs II relies on the hardness of the tooth structure, and not tissue staining, to determine the end-point scientifically. Its specifically designed Knoop hardness (harder than diseased dentine but softer than healthy dentine) allows the bur to remove soft carious dentine selectively while not cutting the harder healthy dentine.

A carbide or diamond bur can inadvertently penetrate through the thin remaining dentine into the pulp (Figs. 2 & 3). SmartBurs II, however, is degraded by healthy dentine and ceases to cut (Figs. 4 & 5). These burs are used after the initial caries access preparation has exposed the deep, underlying caries. In cases in which the caries is exposed (Fig. 6), these instruments can typically be utilised without the need for local anaesthetic because they do not traumatise or open healthy dentinal tubules (Fig. 7).

_Cavity disinfection

It is well established that some bacteria remain in the prepared tooth structures, no matter how thorough the preparation process, and despite a tactile firmness and non-stained appearance. It is now possible to greatly decrease the likelihood of viable bacteria beneath the restoration by chemotherapeutic methods that can penetrate as far as 2 to 3 mm into the remaining enamel or dentine. These techniques effectively destroy bacterial viability and permit the subsequent remineralisation of compromised tooth structures.

The technologies that have been shown to be effective surface bactericides are:

_ASEPTIM Plus Photo-Activated Disinfection system (SciCan; Fig. 8):[17] This compact unit utilises tolonium chloride to stain liposomes specifically in bacterial cell walls. The stain is subsequently targeted by a red diode light that releases oxygen ions (Fig. 9). These ions break the liposomes open, rupturing the cell walls, and killing the bacteria.

_The ions are immediately, and selectively, toxic to bacteria. A very low level of ozone concentration is required for a comprehensive bactericidal effect.[18–20]

_HealOzone (CurOzone USA; Fig. 10): The ozone ions are generated remotely and introduced to the tip-sealed tooth surface through a handpiece. The high concentration of ozone is very effective in bacterial wall disruption and destroys bacteria within 20 to 40 seconds (Fig. 11).[21–24] HealOzone unit is available at www.ukdent.com.

Fig. 8

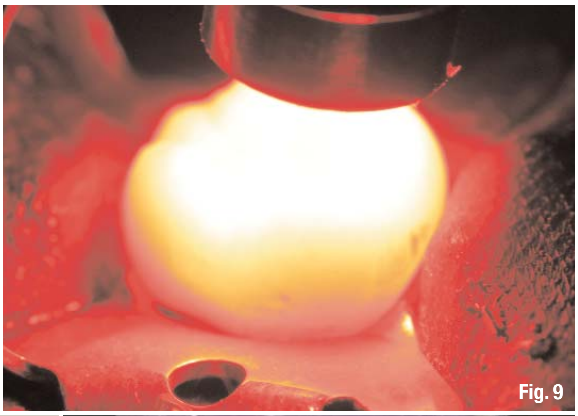


Fig. 9


Fig. 10

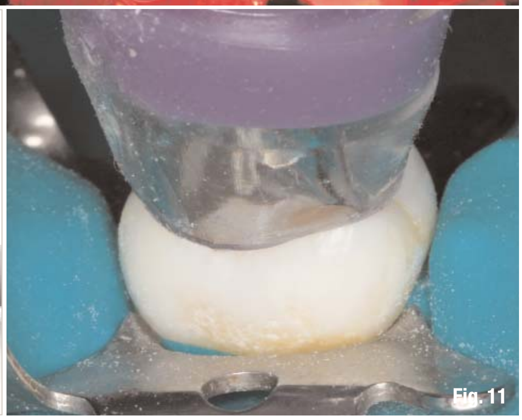


Fig. 11

Fig. 12

Fig. 13

Fig. 14

_Simplification of the restorative protocol

Most restorative protocols require numerous materials, each selected for particular beneficial properties, numerous steps and a cumulatively complex description of the specific sequence that must be followed exactly.

For example, micro-hybrid composites have excellent compressive strength for occlusal surfaces, *but* they may not flow and adapt to margins and undercut areas of the preparation and can be difficult to sculpt. Flowable composites can adapt readily to the micro-anatomy of the tooth surface and are very polishable *but* cannot withstand the masticatory forces of direct occlusal contact.

Beautifil Flow Plus (SHOFU) introduces a new category of restorative material: the "injectable" flowable composite resin (Fig. 12). Based on giomer chemistry, it is neither a conventional composite nor a flowable resin; Flow Plus is a unique blend of these materials with the benefits of both. Its high-strength resin matrix is densely packed with fillers optimised to 67 per cent.

Beautifil Flow Plus has a higher yield point than other flowables; thus, it is not deformed by the strong occlusal forces placed on the posterior teeth. Owing to its excellent physical properties, Beautiful Flow Plus is indicated for restoring both anterior and posterior teeth, and it is suitable for the occlusal surfaces of posterior teeth.

Two viscosities are available, a sculptable non-flow F00 (Fig. 13) and a low-flow F03 (Fig. 14), which are used together in the resin cone technique. Both are suitable for the occlusal surfaces of posterior teeth. The highly elastic Beautifil Flow F 10 is placed after the adhesive for interface stress relief. Then, the non-flow is injected to form cusps and marginal ridges. It injects smoothly from the syringe, retains its shape, and does not develop a dispensing horn. Beautifil Flow Plus is not subject to technique sensitivity, and the cone injection technique offers an important time advantage when compared with the layering technique. Beautifil Flow Plus F 03 is placed last to finalise the occlusal anatomy of the restoration and to seal the marginal areas.

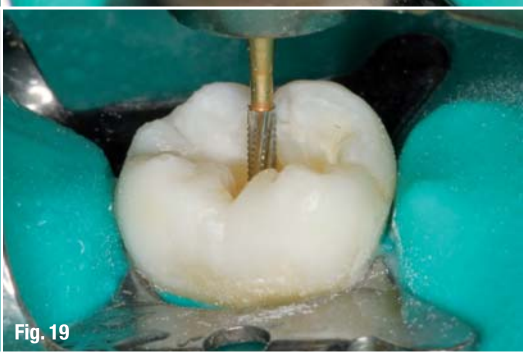
Used individually, or preferably together, these innovative techniques and materials provide prac-

Fig. 15


Fig. 16


Fig. 17


Fig. 18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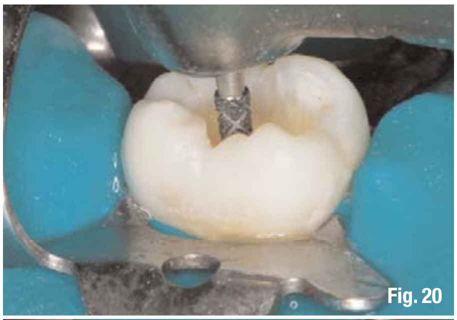
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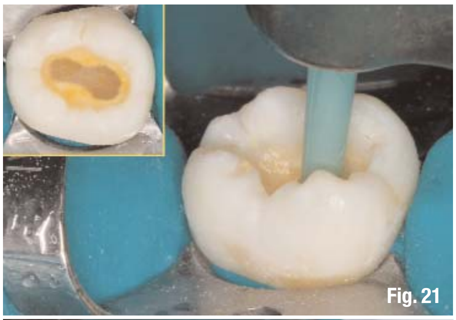
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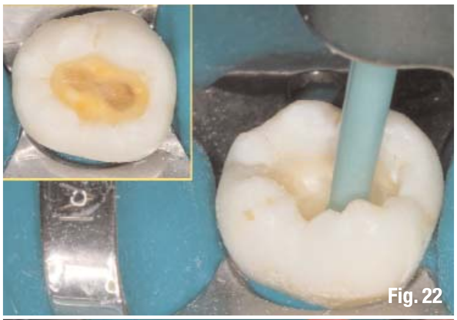
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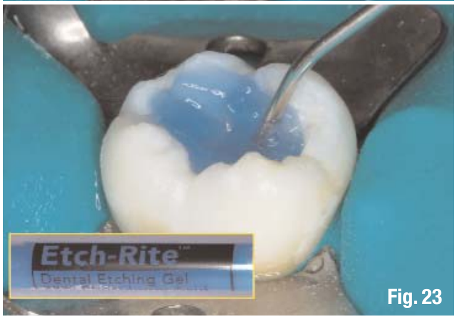

Fig. 23


Fig. 24


Fig. 25

tical clinical solutions to the concerns listed above. The following section details step-by-step an effective protocol that incorporates the latest advances in restorative dentistry.

_Clinical protocol

The rubber dam is punched and lubricated with water-soluble Wink (Pulpdent; Fig. 15) to facilitate its insertion through interproximal contacts without tearing. Vita Easyshade Compact (Vident) is used to determine the shade of the restorative material at the beginning of the procedure, either before the rubber dam is placed, or immediately afterwards (Fig. 16). It is important to record the shade while the tooth is still moist; once it is desiccated, the tooth will appear unnaturally chalky and opaque. The tooth is air-dried and the CarieScan PRO caries indicator (CarieScan; Fig. 17) is utilised to confirm the location and the extent of the decay (Fig. 18).[25–28]

Access through the enamel is created with a Great White Gold #2 carbide[29] (Fig. 19) or a TDA #849 diamond high-speed bur (Fig. 20; both from SS White).[30] Once the deep decay has been exposed, SmartBurs II selectively removes the soft carious (infected) dentine (Fig. 21). The structure of SmartBurs II is designed to determine the preparation end-point automatically; any further rotation of the bur in the cavity simply abrades the bur, not the dentine. This leaves the harder, remineralisable (affected) dentine covering the pulp chamber intact (Fig. 22).

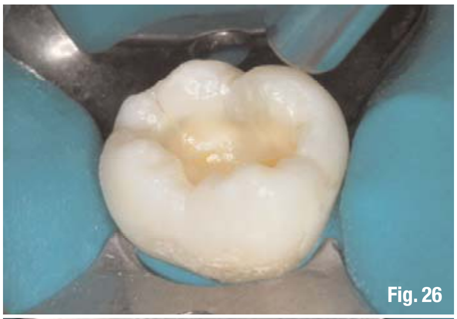
Fig. 26


Fig. 27


Fig. 28

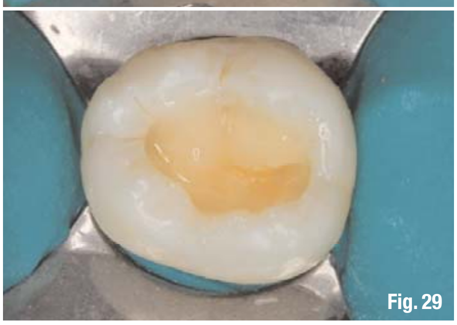
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Fig. 33


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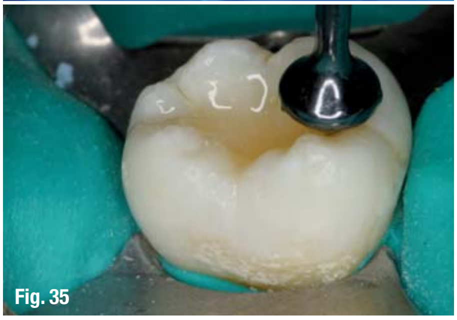
Fig. 35


Fig. 36


Fig. 37

The restorative process begins with an optional etching step; seventh-generation adhesives do not require a separate etching step. A brief etch, 15 seconds or less, is unlikely to harm the bonding strength of the dental surfaces. Etch-Rite (Pulpdent) is applied to the enamel first and then the dentine (Fig. 23) and rinsed off with copious water less than 15 seconds later (Fig. 24). Then, the prepared tooth surfaces are disinfected with the ASEPTIM Plus, Ozonix or Healozone. Each of these treatments takes one minute or less of chair time, and offers greatly improved restorative predictability. BeautiBond seventh-generation single-component, single-step adhesive (SHOFU) is applied to all prepared dentinal and enamel surfaces (Fig. 25). It is left undisturbed for ten seconds, and is then completely dried with an oil-free air syringe (Fig. 26). BeautiBond is then polymerised with a FUSION high-power LED curing light (DentLight; Fig. 27).

Next, the cavity is filled utilising the innovative resin cone technique (as opposed to the more laborious and time-consuming layering technique). Sculptable Beautifil Flow Plus F 00 is injected onto the bonded surface of the preparation (Fig. 28). The composite forms into cones at the bases of the buccal cusps (Fig. 29) as it adapts intimately to the preparation. Since Flow Plus F 00 is a non-flow resin, it stays where it is placed until curing. Flow Plus F 00 is then injected to form the cones at the bases of the lingual cusps (Fig. 30), from the cavity floor to the occlusal, until all four cusp bases have been restored (Fig. 31). The injected cones are then polymerised with the Fusion curing light (Fig. 32). Once the cone build-up is complete, Beautifil Flow Plus F 03 is injected to seal the marginal areas (Fig. 33) and the valleys between the cones (Fig. 34). Flow Plus F 03 is a low-flow material that can readily be shaped by the Duckhead instrument (Hu-Friedy; Fig. 35) prior to final light curing (Fig. 36). The Duckhead composite instrument minimises (and in many cases, eliminates) the need for occlusal adjustment and polishing, further improving the efficiency of the restorative protocol. The completed restoration (Fig. 37) demonstrates the clinical result of the technique and material enhancements that are available to the practitioner today.

_Conclusion

Innovations in end-point determination, cavity surface disinfection, and the simplification of restorative techniques have again revolutionised dental practice. Mainstream clinical procedures are better, faster, easier and much more predictable in the long term._

Editorial note: A complete list of references is available from the publisher.

_about the author

cosmetic dentistry

Dr George Freedman is past president of the American Academy of Cosmetic Dentistry and the Chairman of the Dental Innovations Forum (Singapore). He is the author or co-author of 11 textbooks, more than 400 dental articles, and numerous CDs, videos and audiotapes, and is a member of the REALITY editorial team. His most recent textbook is “Contemporary Esthetic Dentistry” (Elsevier). Dr Freedman is co-founder of the Canadian Academy for Esthetic Dentistry and a diplomate of the American Board of Cosmetic Dentistry.

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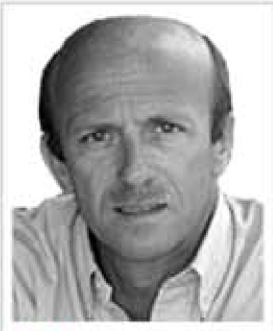
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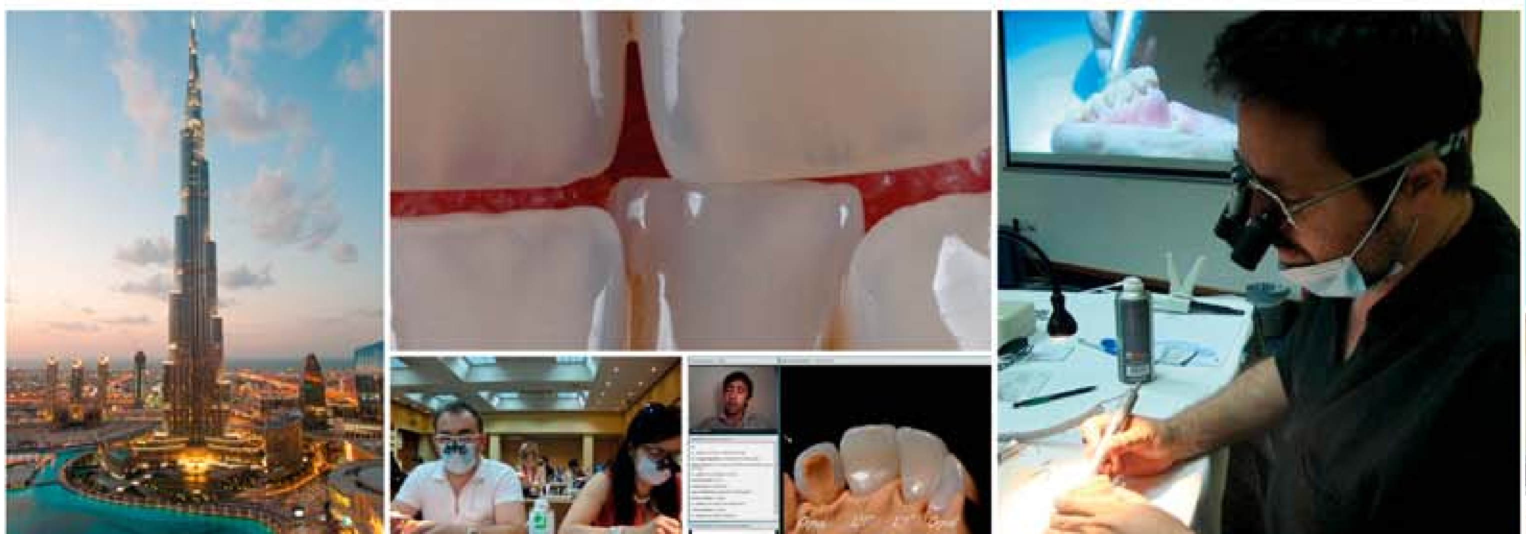

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