By Dr Didier Dietschi, Switzerland

Introduction

Restorative dentistry has entered a phase of deep conceptual rupture, demarcating two camps, the traditional one, pursuing the convention of humans-conceived and fabricated restorations, and the modern one, celebrating new technologies in all aspects and steps of a restorative treatment and limiting tremendously the manual contribution of the dentist. However, even the most enthusiastic, modern professionals recognize that no technology can equate to the excellence and perfection of a powerful brain and agile hands acting in synergy, while the most conservative ones also admit that digital dentistry has the potential to elevate the level of mass dentistry. What is the most reasonable attitude? Probably a position in between the extremes. Freeway direct bonding can then be looked at from different perspectives as well: it will soon be abandoned and replaced by either CAD/CAM and 3-D printed restorations, or on the contrary, even further developed, using some new digital technologies to improve its outcome and practicality, fueled worldwide by a slowing economy and the quest for an ultraconservative treatment approach. The latter vision is from the most realistic one, as many restorations cannot be approached simply by new technologies owing to the limits of geometry or restorative geometries and the irrational complexity, preparation imprecision or technology immunity of CAD/CAM and 3-D printing systems if applied unrestrictedly.

This report aims then to discuss and illustrate current and future indications and application protocols of direct bonding, as a way to bridge classical and modern dentistry.

Overall considerations and indications for direct bonding

The use of composite is likely to continue, probably even develop, in the forthcoming decade. Actually, no foreseeable new technology seems able to allow soon the intraoral fabrication of highly aesthetic and strong restorations in a simple, efficient and cost-effective way. In the case of extraoral fabrication, tapered cavities or at least different cavity designs are required, generating as well undesired complications and costs. Keeping this in mind, direct composite application has its advantages in the following precise indications (Figs. 1a-e):1, 2 –Class III–IV restorations; ––form corrections indicating natural tooth shape; proportions and dimensions (tooth shape; proportions and dimensions); (aiming for treatment reversibility), reduced execution time and lower cost (as opposed to indirect or CAD/ CAM restorations), providing also a satisfactory longevity.1, 2 Conversely, some limits exist, related to the practitioner’s experience, composite shading and layering concept (some systems are still overcomplicated and unreliable in terms of esthetic/ shade outcome) and application of detailed protocols, although the last shortcoming is truly a relative one. The use of direct techniques has only few limitations in terms of extent, namely nonvital teeth or very large carious lesions, for which crowns or extended bonded porcelain restorations are usually preferred. Likely in-between indications for direct or indirect solutions – some cases lie within a gray zone – are resolved mainly according to the operator’s preference rather than any other strong rationale (Figs. 2a-s).

Shading and layering concept

Overall, layering concepts evolved from a primitive approach to emulating natural dental anatomy and optical properties to more reliable protocols for matching tooth color and its many dimensions.5-7 Actually, color integration as perceived by patients implies correct hue, opacity, opalescence and fluorescence regarding optical deter- minants and surface gloss and light reflectance (mainly related to the restorative microanatomy). An optimal result in terms of esthetic integration is feasible today, although it will rarely be achieved without proper material choice and an appropriate layering approach and application, which are largely product-specific.

We normally classify composite systems in relation to the number of recommended layers, as well as some selected optical properties, which allow for finer differentiation among brands. In parallel, filler technology has considerably evolved, aiming to offer the practitioner various options, such as universal materials (supertint hybrids or homogenous nanohybrids), which can be used for both posterior restora- tions, owing to their excellent mechanical properties, wear resistance and esthetics, or specific composite formulations (spherical or mixed-filler composites) aimed to be used mainly in anterior teeth owing to lower mechanical performance. Our preference today is toward universal composites as far as material technology is concerned and a bimodal application approach, considered simple, reliable and highly esthetic.

The use of the natural tooth as a model has been then a logical evolu- tion of direct restorative materials, leading to an improved shading and layering concept; the natural layering concept (NLC), logically named after nature’s original model and source of inspiration.1, 2 It resulted from a comprehensive study of natural dentin and enamel optical prop- erties, recognizing the variations in tissue quality related to tooth age and functional maturing. Related findings have logically driven the lines of this new concept (Fig. 3).1-5 Spectrophotometric measurements (tristimulus L*a*b* color and opacity values) of natural teeth belonging to various VITA shade groups led to the conclusion that the use of different dentin colors for a direct composite restorative system could be avoided, provided that enamels would offer not only different value/opacity lev- els but also different tints. Likewise, limited natural dentin opacity with- in a given chroma level variation did not support the use of different den- tin opacities (i.e., translucent, regular or opaque dentin).1, 5, 9 Then, a new concept was born, allowing the emulation of practically all of the VITA shades by using an appropriate combination of universal dentin shades of a single opacity level and presenting a wide chroma range that extends beyond VITA classical shades and multi tint/multi-translucency enamel (typi- cal brands: e.max). After their develop- ment period: Cer in form and color and for posterior finishes: Emax (VITA). Effects shades

For teeth with richer color composition (strong opalescent halo, noticeable dentin mamelons, enamel opacities etc.), special effect shades produced in a flowable consistency are available in some NLS systems to surpass esthetic boundaries (typical brand inspiri). Case presentation

A patient, aged 16, presented with an aesthetic complaint, after orthodontic closure of spaces owing to missing lateral incisors. The functional
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esthetic analysis revealed improper distribution of teeth and extra space (Figs. 2a & b). A more detailed analysis of the smile showed excessive space distal to the maxillary right lateral and mesial to the maxillary left one, associated with an excessive diastema between both central incisors.

The simulation of space closure with restorations confirmed the need for orthodontic correction; it was decided to use the Invisalign system (Align Technology; Figs. 2c-f) to achieve a better pre-restoration configuration. After better space distribution was obtained (Fig. 2g), a new analysis was performed to assess the potential esthetic outcome of smile enhancement using direct bonding and no preparation approach (Figs. 2h-i). The improved, post-Invisalign configuration confirmed the possibility of obtaining a satisfactory result, although the mesial movement of the four incisors did not allow the possibility of eliminating some remaining excess space.

The preparation of surfaces was limited to sandblasting, after rubber dam placement, as a unique procedure prior to adhesive procedures. Sectional matrices were used to close the diastemas (Adapt system, KerrHawe); the curvatures of which help in increasing the natural convexity of proximal surfaces. The NLC of a bilaminar buildup approach was applied (Figs. 2j-m) with one dentin (Body i2, inspiro) and one enamel (Skin White, inspiro) shade. Small additional increments of effect shades (Azur and Ice, inspiro) were applied to emulate chromatic details and color is not so simple, and improved practicability: a proper shade guide is a crucial tool to achieve optimal color integration of the future restoration. Example of a bilaminar shade guide (inspiro), which allows individual selection of dentin and enamel shades, emulating the natural disposition and thickness of dentin and enamel with direct bonding in a predictable manner. This is where existing technologies can make a significant contribution in the form of digital diagnostics (digital smile design) and 3D printed mock-ups to support treatment planning, constrain clinical difficulties and, therefore expand successful use of direct bonding. The next milestone in treatment reliability is the use of a highly effective and simple layering approach such as the NLC. The last two improvements in direct bonding application are keys to success for the modern practitioner.

Conclusion
As said, the freehand application of composite is to remain and even likely to further develop, and we do not foresee new techniques challenging the simplicity and efficiency of direct composites. Actually, on one hand, 3D intraradial printing of composite restorations with a high filler load seems unlikely to happen soon owing to the viscosity of such material, while on the other hand, extraradial fabrication would require a tapered cavity design with a significant, nonconservative alteration.

In short, there is not any technology that can replace direct composites yet. Having said that, achieving optimal forms, smile configuration and color is not so simple, and improved clinical protocols are needed to obtain highly esthetic results with direct bonding in a predictable manner. This is where existing technologies can make a significant contribution in the form of digital diagnostics (digital smile design) and 3D printed mock-ups to support treatment planning, constrain clinical difficulties and, therefore expand successful use of direct bonding. The next milestone in treatment reliability is the use of a highly effective and simple layering approach such as the NLC. The last two improvements in direct bonding application are keys to success for the modern practitioner.

About the author

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Dr. Didier Dietschi received his DMD in 1984, his MD in 1989, his PhD in 2003 and his habilitation qualification (post-doctoral) in 2004, all from the University of Geneva, Switzerland. He is currently a senior lecturer at the university and an associate professor at Case Western Reserve University in Cleveland, Ohio, U.S. Dr. Dietschi is in charge of anterior esthetic restorations and periodontal and implant surgery at the Geneva Smile Center.

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