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Clinical Application of the "Natural Layering Concept"

by
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Introduction

Composite resins occupy a paramount position among restorative materials because they offer excellent aesthetic potential and acceptable longevity, with a much lower cost than equivalent ceramic restorations for the treatment of both anterior and posterior teeth (Osborne et al, 1990; Hickel and Mahnart, 2001). In addition, composites restorations allow for minimally invasive preparations or no preparation at all for achieving the replacement of the decayed or missing tissues.

The creation of perfect direct restorations has long been an elusive goal because of the imperfect optical properties of composite resins and also because of improper clinical procedures. The attempt to mimic the shades and layering techniques developed for ceramic restorations lead to complicated application methods, controllable only by highly skilled practitioners. This has limited for years the number of patients who could benefit from the tremendous advantage of direct composite restorations. The use of the natural tooth as a model and the identification of respective dentin and enamel optical characteristics (tristimulus L*a*b* color measurements and contrast ratio) has been a landmark in developing better direct tooth coloured materials. (Cook and McAree, 1985; Dietschi et al, 2000).

The "Natural layering concept" is a simple and effective approach to the creation of highly aesthetic direct restorations. Since this concept has become a reference in the field of composite restorations, the aim of this paper is to familiarize the practitioner with the features and clinical aspects of this new technique.

Optical characteristics of human dentin and enamel and their influence on composite shading and layering concepts

The dentin L*a*b* color measurements of teeth from the "A" and "B" VITA shade groups have suggested that an ideal dentin replacement material should exhibit the following characteristics:

- single hue
- single opacity

• broadchroma scale (beyond the 4 chroma levels of the VITA system)

Actually, the variations of a* and b* values between “A” and “B” VITA shades seem not to justify the use of distinct dentin colours, at least for a direct composite restorative system. Likewise, the variations of the contrast ratio (opacity-translucency) within a single shade group do not support the use of different dentin opacities (i.e.: translucent, regular or opaque dentins). However, chroma (related to a* and b* values) proved to increase from light to dark shades (A1 to A4 or B1 to B3) and therefore support the concept of a broad chroma scale covering all variations of natural dentitions, plus some specific conditions like sclerotic dentin (as found underneath decays, fillings or cervical lesions).

With regard to enamel, differences in tissue lightness and translucency proved generally to vary in relation to tooth age and therefore confirmed the clinical concept of 3 specific enamel types (Ubassy, 1983):

• Young enamel: white tint, high opalescence, less translucency

• Adult enamel: neutral tint, less opalescence and intermediary translucency

• Old enamel: yellow tint, higher translucency

This interpretation of human dentin and enamel colorimetric data led to this clinical approach named the “Natural Layering Concept”, which embraces more accurately the optical and anatomical characteristics of natural teeth (Dietschi, 1995, 1997 and 2001; Dietschi et al, 2000). It actually defines the features of an optimal restorative material aimed to replace dentin and enamel, respectively. Dentins shades should be available in one single hue (Vita “A” or Universal dentin shade) with a sufficient range of chroma (covering at least the existing Vita shade range) and presenting opacity close to that of natural dentin. Enamel shades should present different tints and opacity levels, tentatively replicating all variations found in nature. Typical brand names are Ceram-X duo (Dentsply), Miris (Coltenwhaledent), Enamel HFO (Micerium).

Influence of the Natural layering concept on shade recording

The quality of the final restoration of course depends on a correct shade recording. According to the “Natural Layering Concept” there are only 2 basic steps involved: -1: selection of dentin chroma in the cervical area, where enamel is the thinnest, using samples of the composite material, - 2: selection of enamel tint, often performed by simple visual observation. In specific and less frequent cases, a third step might be involved in the form of a visual or photographic mapping of the tooth special optical effects (such as white hypocalcifications, high opalescence areas or areas with a higher chroma). In this situation, the application of effect materials (white, blue or orange-gold; Miris Effects, Coltenewhaledent, xxxCosmedent) might be recommended.

Case reports

Case 1:

A young patient presents a large fracture of the left central incisor which necessitates a replacement for aesthetic and functional reasons; in addition, both central incisors present an asymmetrical mesio-distal dimension (Fig.1A). Shade selection is always performed first, to avoid any interference in chroma and opacity evaluation due to tissue dehydration. Shade selection includes 2 basic steps; dentin chroma is first selected with the dentin shade tab next to the cervical region of the reference tooth (Fig.1B). Then, enamel tint is confirmed by placing either the enamel shade tab or a small piece of the light cured material, next to the incisal border (Fig.1C).

Fig.1A

Preoperative view: the right central needs to be enlarged and the left central incisor shows an unsatisfactory class IV composite restoration.

Fig.1B

Dentin chroma is selected by placing the shade sample next to the cervical area of the intact contra-lateral tooth.

Fig.1C

A small piece of light-cured enamel mass is placed above the incisal third to select the right tint.

Fig.1D

A silicone index fixes the information of the incisal edge position.

Subsequently, a silicone index is fabricated to fix the lingual profile and incisal edge position; the index will be used during the next steps and possibly also at the time of finishing as a control of tooth length (Fig.1D). Before proceeding with the restoration of the left central incisor, the diameter of the right incisor has to be corrected (Fig.1E). Enamel is applied on the neighboring tooth mesial surface; no preparation is required neither the use of a dentin mass, since only a 1mm thick increment needs to be applied (Fig.1F-G).

Fig.1E

View of the prepared left central incisor

Fig.1F

Mesio-distal diameters are controlled before proceeding with the enlargement of the right central incisor.

Fig.1G

The right central incisor has been corrected by placing a singl enamel increment on the mesial surface.

The selected enamel composite (CeramX duo, E2) is applied directly on the silicone index, which is then placed against the teeth (Fig.1H). This allows the lingual build-up of enamel to be performed easily and precisely (Fig.1I). The reference of the new incisal edge serves for a precise 3-dimensional placement of dentin (CeramX duo D1) (Fig.1J).

Fig.1H

The lingual enamel wall of the left incisor is built-up directly against the index.

Fig.1I

Completed enamel wall.

Fig.1J

The dentin increment is thereafter placed with a correct position in regard to the future incisal edge, respecting also the specific tooth configuration.

A little increment of blue tinted composite (Miris, Blue effect) was later added on top and -between dentin peaks to mimic opalescence of natural enamel; this was judged necessary since the intrinsic opalescence of the composite enamel seemed insufficient in this case. Finally, a last layer of translucent, enamel mass (same as used on the lingual surface) is applied to complete the proximal and buccal profiles and provide desired translucency and brightness (Fig.1K). Finishing and polishing allows giving both teeth their final morphology and final dimensions (Fig.1L-M). The application of the natural layering concept through a logical application of two separate composite masses which mimic natural tooth anatomy presents clear advantages for the clinician; it makes the whole procedure more efficient and predictable.

Fig.1K

A final enamel layer has been applied on proximal and buccal surfaces to complete the restoration.

Fig.1L

Completed restorations after finishing and polishing.

Fig.1M

Final view after tissue rehydration.

Case 2:

An adult patient presents old defective amalgams which require their replacement (Fig.2a). The rubber dam is placed before removing the amalgams to prevent inadvertent ingestion of metal powder or inhalation of mercury vapors. The cavities are prepared and tissue cleaned without the need to follow a specific cavity outline; this represents a major advantage of direct adhesive techniques in posterior teeth (Dietschi and Spreafico, 1997).

Fig.2A

Preoperative view showing the decayed restoration.

Fig.2B

Both cavities are prepared. Cavity configuration and size are adequate for a direct technique with all proximal margins in enamel.

After adhesive application (Prime & Bond NT, Dentpsly), the composite was inserted following the horizontal incremental technique (Lutz and Kull, 1980). The proximal ridge is built-up first, usually in 2 or 3 increments of about 1mm each (Fig.2C).

Fig.2C

A sectional matrix and stabilization ring are used to box the cavity and seperate teeth in order to achieve a tight proximal contact. The marginal ridge is built-up first with 2 or 3 horizontal layers of enamel (ceram•X® duo E1.

Fig.2D

Dentin is applied on the bottom in the remaining occlusal portion of the cavity (ceram•X® duo E3. Sufficient space must be maintained in the central area and at the margins for enamel application.

Fig.2E

A final enamel layers is placed and free-hand sculpted before light-curing. This will allow a natural and functional anatomy to be developed.

A sectional matrix was used, which is stabilized by a metal ring; in addition, the ring creates a slight separation of neighboring teeth and provides a perfect tight proximal contact (i.e.: System Palodent-Dentsply) (Fig.2C & F). In addition to this specific incremental technique, the natural layering concept is also followed which will improve the aesthetic appearance and integration of the restoration. It implies the use of dentin masses to replace missing dentin (CeramX-duo D1 to D4) (Fig.2D & G)) and enamel masses to replace missing enamel (CeramX-duo E1 to E3) (Fig.2E & H); this confers the simplicity and beauty of this new layering approach.

Fig.2F

The same procedures are repeated for the first molar. Both mesial and distal ridges are built-up with enamel.

Fig.2G

Dentin increment

Fig.2H

Completion of the occlusal surface with enamel.

A special sculpting technique is used to develop a natural occlusal anatomy which provides aesthetics and function (Fig.2I). Restorations placed with this technique require practically no finishing procedure, except the smoothing of proximal margins and occlusal adjustments. The final views demonstrate the quality of the restorations and their ideal anatomy and function.

Fig.2I

Postoperative view demonstrating the good aesthetic and anatomical integration of both direct restorations.

Conclusion

The natural layering concept has enabled patient's aesthetic expectations to be fulfilled in a predictable way by incorporating newly acquired knowledge about natural tissue optical properties into a new composite system. In addition, this has allowed for a significant simplification of clinical procedures, making this technique also accessible to general practitioners. This advance can be regarded as a milestone in operative Dentistry, giving a new input to free-hand bonding and helping more patients to receive conservative and highly aesthetic restorations.

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