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Resin composite layering technique for direct anterior teeth restorations

Stratificarea materialelor pe bază de răşini compozite în restaurări directe ale dinţilor frontali

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Abstract

Background. Composite resins can be successfully used to improve the patient's esthetics through minimally invasive, low cost and high clinical performance treatments. The layering techniques of composite resins in different thicknesses, with varying degrees of opacity and translucency, permit the creation of esthetic restorations with tooth structure characteristics.

Aims. The aim of the study was to evaluate the characteristics, principles and methods of stratification of resin composite materials and to exemplify these methods with clinical cases.

Methods. An electronic search of scientific articles referring to the stratification of composite materials was done using a single medical database: PubMed. The focus on the selection of keywords as well as the inclusion and exclusion criteria were the guiding elements of the research. All articles were included after the title, the abstract, and finally the full text was checked. Only relevant research was reviewed. Based on the results, several methods of stratification were used in clinical practice.

Results. The concept of natural stratification, anatomical stratification, stratification of the anterior teeth using a dentin hue and a predefined thickness of enamel, or a single layer of material and the correct placement of pigments and opacities lead to the achievement of esthetic and predictable direct nanocomposite resin restorations.

Conclusions. Within the limit of this study, it can be concluded that, to achieve aesthetic excellence, dentists should understand and apply artistic and scientific principles when layering materials, respecting the optical properties of natural dental structures.

Key words: composite resins, stratification, optical properties

Rezumat

Premize. Răşinile compozite pot fi folosite cu succes pentru a îmbunătăţi estetica pacientului prin tratamente minim invazive, cu performanţe clinice înalte şi la un preţ de cost redus. Tehnicile de stratificare a răşinilor compozite în diferite grosimi, cu diferite grade de opacitate şi transluciditate, fac posibilă obţinerea unor restaurări estetice cu aceleaşi caracteristici ca cele ale structurilor dentare.

Obiective. Scopul studiului a fost de a evalua caracteristicile, evoluţia, principiile şi metodele de stratificare a materialelor pe bază de răşini compozite.

Metode. S-a realizat o căutare electronică a articolelor ştiinţifice referitoare la stratificarea materialelor compozite, utilizând o singură bază de date medicală: PubMed. Prezenţa cuvintelor cheie, precum şi a criteriilor de includere şi excludere au fost elementele care au ghidat selectarea articolelor. Toate articolele au fost incluse în studiu în funcţie de titlu, rezumat şi în final, a fost verificat si textul complet. Doar cercetările relevante au fost selectate şi analizate.

Rezultate. Conceptul stratificării naturale, stratificarea anatomică, realizarea restaurărilor biomimetice, stratificarea dinţilor anteriori folosind o nuanţă de dentină şi o grosime predefinită de smalţ sau a unui singur strat de material şi plasarea corectă a pigmenţilor stau la baza realizării restaurărilor directe estetice din răşini compozite.

Concluzii. În limitele acestui studiu, se poate afirma că, pentru a atinge excelenţa estetică, stomatologii ar trebui să înţeleagă şi să aplice principiile artistice şi ştiinţifice atunci când realizează stratificarea materialelor de restaurare directă, respectând proprietăţile optice ale structurilor dentare naturale.

Cuvinte cheie: răşini compozite, stratificare, proprietăţi optice

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Introduction

Composite resins are a well personalized class of restorative materials with specific indications in the anterior and posterior areas of the mouth. Their advantages reside in: easy to use, reduced number of treatment sessions, very good bonding to the dental structure and wide variety of materials available on the market. Also, composite resins can be effectively used to improve smile aesthetics through minimally invasive treatments at low cost and high clinical performance (Chen, 2010; Prodan et al., 2015)

The concept of resin composites layering is a real interest for practitioners because the aesthetic aspect, particularly important for patients, can be rendered by stratification techniques, directly in the dental office. However, clinical success depends on choosing the type of composite resins. This must be done taking into account both the optical properties we want to achieve and, above all, respecting certain characteristics of natural dental structures such as translucency, opalescence and fluorescence.

Artificial reproduction of all the intrinsic properties of the tooth is not always a simple task because the enamel, dentin and pulp forming the dental crown are different in thickness, composition, structure, and especially, optical properties. The dental pulp has a lesser impact upon the general optical aspect, but the dentine is characterized by an opaque and rich complex, with varying degrees of saturation and fluorescence, and has a well-defined chromatic role. It is covered with a layer of enamel, which is translucent and opalescent (Prodan et al., 2015). Dentin and enamel have different thickness distributions in the dental crown, so the chromatic and translucent optical properties vary from cervical to incisal. At the cervical level, a greater amount of dentin is visible through the transparency of the enamel, so at this level there is a higher saturation of the dental color, while at the incisal level, the predominant presence of the translucent enamel gives gray-blue, gray-white or white-yellow aspects (Prodan et al., 2015; Villarroel et al., 2011).

Achieving perfect direct restoration has been, over time, a difficult task to achieve, because of the imperfect optical properties of composite resins and unpredictable clinical procedures. Therefore, the improvement of stratification techniques in different thicknesses of composite resins, with different degrees of opacity and translucency has been attempted, with the aim of obtaining aesthetic restorations with characteristics as close as possible to those of the natural dental structures. Nevertheless, current composite resin systems are provided so that "dentin" materials reproduce the shade and fluorescence of natural dentin and "enamel" materials mimic the opalescence and translucency of natural enamel.

Objectives

The objective of the study was to evaluate the characteristics, the principles and the methods of layering the composite materials. This study wishes to assess whether the concepts of layering the resin composite materials is done respecting the optical properties of natural dental structures.

Hypothesis

This study starts from the hypothesis that the methods of layering of composite materials are designed respecting the optical properties of natural dental structures.

Material and methods

An electronic search of scientific articles with reference to dental composite layering technique was done, using a single medical database: Pub Med. A total number of 174 articles were found. The publication date range has been set from year 2000 to 2018. The articles were selected using specific keywords (layering composites resins, stratification, and direct composite resin), inclusion and exclusion criteria. Articles with topics on: dental resin composites, layering technique, shading concept, anterior region of the oral cavity were selected. Exclusion criteria were: studies analyzing mechanical properties and studies for posterior restorations. After analyzing the title, 49 articles were selected. Then, after reading the abstract and the full text articles, only relevant researches were taking into consideration, most of them being literature reviews or case reports.

Based on the results, several methods of stratifications have been used in clinical practice.

Results

According to the literature, several direct stratification methods were used: the concept of natural layering, anatomical layering, biomimetic restorations, double shade composites layering for anterior teeth, using a dentin shade and a predefined thickness of enamel shade, or a single layer of material and the correct placement of pigments and opacities. Some of these techniques may have variations (Table I), (Dietschi, 2001; Dietschi et al., 2006; Dietschi & Fahl, 2016; Blank, 2003; Beddis & Nixon, 2012; Ardu & Krejci, 2006; Manauta et al.,2014a; Manauta et al.,2014b).

Shading and layering concepts progressively evolved from a simplistic, non histo-anatomical, bilaminar

Table I

Historical perspective of various layering concepts applied to direct anterior composite restorations

Time	Layering technique	Shading concept
2000/2006/2013	Bi-laminar Natural layering shading	Universal dentin+multi tint and translucency enamels Non-Vita shading
2002/2011	Polichromatic	Dentins+body shades+chromatic enamels+incisals Vita shading
2003/2010	Bi/multi laminar	Universal dentin+value and effect enamel Non-Vita shading
2014	Histo-anatomical layering (penta laminar)	Deep dentin and superficial dentin shades+dentin-enamel jonction liner+deep and superficial enamels

technique to a multi-layering approach, using composites with shades corresponding to the Vita Classic™ system.

It has been introduced also a polychromatic layering, which consists in using a variable number of layers of resin composites with different translucencies:opaque dentin, chromatic enamel and translucent/opalescent enamel, driven by the natural tooth optical composition.

In parallel with this evolution, a simplified, non-VITA shading system was developed, with a reduced number of layers (basically dentin and enamel layer, plus effect shades if required) known as the natural layering concept. (Dietschi & Fahl, 2016)

Discussions

To ease understanding of stratification techniques, we follow the classification according to the number of layers used in the restoration: In this respect, one layer, two or three different layers of composite materials can be stratified, or even complex layering can be done, using several shades in different thicknesses and opacities, and specific pigment-based individualizations.

Clinical protocol for direct restorations in the anterior area

Restorations in the anterior area of the oral cavity involve the biomimetic reproduction of the natural teeth characteristics in order to achieve aesthetic restorations as well as integrated into the dental arcade. For this, two essential steps are needed: dental color determination and selection of composite resin materials to be layered.

a) Color evaluation in cosmetic dentistry is one of the most difficult stages in direct restoration. Color should be understood as a result of the interaction of three dimensions known as hue, saturation and brightness.

Determination of dental color can be done by direct or indirect methods. A preliminary determination of the dental color will be done with the spectrophotometer to have a reference point, followed by the visual dental color determination with shade guides, aiming at the same time to observe the individual aspects (areas of incisal or proximal translucency, increased opacities, pigments, cracks, etc.). It is recommended to use customized and individualized shade guides, layered in different color and thicknesses, made from the same material as the future filling. Determination of dental color involves the analysis of each dental area (cervical, medium and incisal third) in order to make a dental map of different colors and translucent areas (Joiner, 2004; Stevenson, 2009).

The "button try" technique was recently introduced; it consists on placing small amounts of different shades of the resin composite, on the vestibular surface of the tooth to be restored and then photo-polymerized (Lee, 2010)

b) Dental composites materials and stratification techniques will be chosen in order to create a restoration that matches and blends in the adjacent natural dental tissues. To actually imitate dental structures, restorative materials must present both similar optical properties and have a similar refractive index to that of dental tissues.

In addition to choosing the stratification technique, it is important to select properly the materials, as to obtain chromatic effects of depth, that characterize the natural teeth (Dudea & Varlan, 2013).

Layering methods used for direct anterior teeth restorations

- *One-layer layering techniques* is a common and simple layering technique,that involves a single group of materials, either dentin or enamel, to restore the defective natural tooth. It is usually used for masking the white spots on the teeth (Fig. 1).

Fig. 1 – One layer technique for treating the white spots on the anterior teeth:a) initial aspect, b) after treatment

- *Two-layer stratification techniques* requires a higher level of clinical skill , because it uses both dentin and enamel materials during the restoration. It is indicated in case of cervical lesions or for direct composite veneers (Fig. 2).

Fig. 2 (a, b) – Two layer layering technique used in case of cervical abrasion on 1.3-1.6: a) initial aspect of cervical lesion, b) final aspect immediately post-op.

- *Three layer stratification techniques*: this is the advanced level of the layering technique, when opaque dentin, body dentin and enamel materials are used in combination to block the transmission of light (Fig. 3). As opaque materials are used, a good selection of the hue and thickness of the dentin and enamel layers are essential to achieve an aesthetically successful result. It is used to mask the discoloration of teeth with dyscromies.

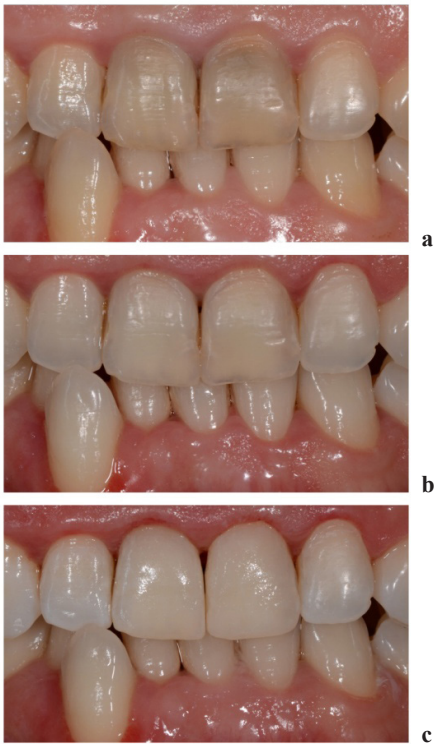

Fig. 3 – Three layer layering technique for masking teeth discoloration

- *Complex layering techniques* involves materials with special color effect (pigments) in restorations. These materials are usually placed between the dentin and enamel layers of natural teeth or of the restorative materials (Fig. 4).

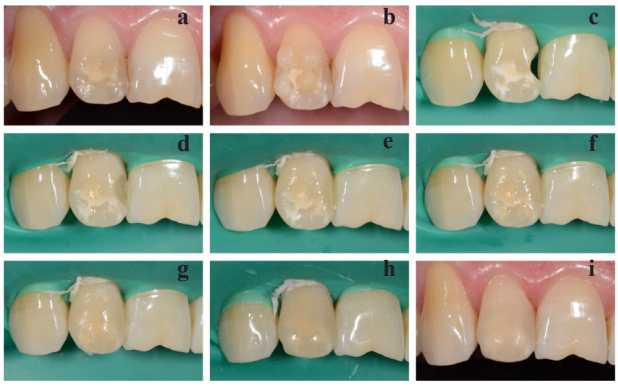

Fig. 4 – The use of special color effect pigment to mask the white spot; warm-gold material (chroma) has been selected to increase the chroma level in the medial area of dentine: a) initial aspect, b) color determination with button try composites, c) aspect of the prepared tooth, d) enamel palatal wall, e) dentin layer, f) pigment placement, g) enamel buccal layer, h), i) final aspect of the restoration

- *Anatomical layering technique* involves using successive layers of dentin, enamel and incisal composite, so that more realistic color depth could be obtained. In the same time, surface and optical characteristics that mimic nature are aimed (Fig. 5).

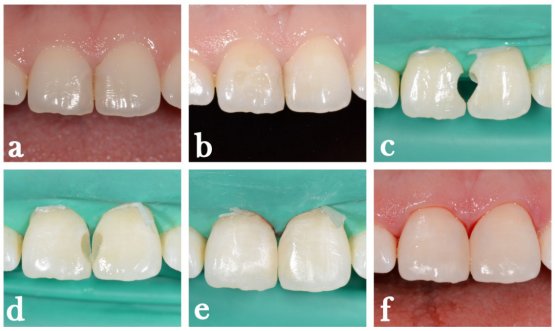

Fig. 5 – Anatomical layering technique: a) initial aspect of cl III restoration located on 1.2, 2.1; b) color determination with button try composites; c) aspect of prepared tooth; d) enamel palatal layer; e) dentin layer; f) final aspect with the buccal enamel layer in place

- *Blended shading technique*. This technique uses two or more shaded restoration materials to match the actual hue of a tooth in different regions. Restorative materials with different colors are used and mixed with overlapping surfaces to create the desired effect (Koirala, 2009).

- *Natural layering technique* (Fig. 6) The concept was introduced in 1995 by Dietschi. It is based on a simplified and more reliable layering technique with only two layers (dentin and enamel) to perfectly mimic the structure and appearance of the tooth. This new approach allows the combination of different enamel and dentine nuances with immediate comparison with the natural tooth (Dietschi et al., 2006). linical applications and stratification of the composites uses only one universal dentine shade (with the opacity close to that of a natural tooth) with several levels of chromacity and three types of enamel for young, adults and old patients, with different shades and levels of translucency (Dietschi et al., 2006; Dietschi, 2009). This concept is used in combination with dental materials classified only in dentin and enamel shade according to the age of natural tooth structure: Miris and Miris2 (Coltene whaledent), Ceram-X duo (Dentsply), Enamel HFO Plus (Micerium), Inspiro (Edelweiss DR), and Essentia (GC) (Dietschi, 2009).

Fig. 6 – Natural layering technique a) initial aspect of cl. III restoration located on 2.2; b) color checking with button try composites; c), d) aspect of prepared tooth; e) enamel palatal layer; e)dentin layer; f) final aspect with the buccal enamel layer in place; g) final aspect 24h post-op.

Conclusions

1. Aesthetic restorations can be provided directly and conservatively, with respecting the optical properties of natural dental structures. Nowadays, the evolution of dental resin composites, and stratification methods are based on improved reliability and clinical simplification.

2. To achieve aesthetic excellence, dentists should understand and apply the art and scientific principles when layering the composite materials. Only the understanding of multiple factors that influence the end result of aesthetic restoration guarantees results with a major positive impact on patients.

Conflicts of interests

None

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