Simplified techniques for the placement of stratified, polychromatic anterior and posterior direct composite restorations.

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Legend for pictures

These are thumbnails only

Actual high resolution pictures for publication attached separately

Figure 1-2 - Preoperative condition. Note large diastemas, narrow, tapered incisors, and the preoperative shade and maverick colors.

Figure 3- After and accurate wax-up is fabricated, a putty silicone matrix is created and relined with a medium body impression material.

Figure 4 – The matrix is loaded with Venus OA2 dentin shade, placed in the mouth, adapted and refined, and cured. The excess is trimmed away, and the teeth separated with an interproximal saw.

Figure 5- The more translucent Venus A2 Enamel was placed in the cervical 1/3 of the teeth, with horizontal grooves left to receive a white tint to mimic the hypoplastic banding found on the natural teeth. The middle and incisal 2/3' s were reconstructed with Venus A1 with labial-lingual incisal "notches."

Figure 6 – White and brown/amber Effect Color tints were added along the gingival 1/3, and sporadically throughout the incisal 1/3 of the teeth. These tints were covered with the highly translucent Venus T1 shade.

Figures 7-8 – The six week postoperative results. Note the polychromatic result, improved shape and contours, and integration with the existing dentition.

Figure 9 – Final portrait depicting the achievement of the patient' s objective of having a new smile that integrated with his existing dentition and " tough guy" image.

Figure 10 – Preoperative view of amalgam to be replaced

Figure 11 – The restoration is removed with a diamond bur.

Figure 12 – Multiple coats of a self-etching primer/adhesive (iBond, Heraeus Kulzer) are applied for 30 seconds, air thinned, and cured.

Figure 13 – A flowable composite (Flowline, Heraeus Kulzer) is placed as a liner covering the pulpal floor and dentinal walls, just short of the DEJ.

Figure 14 – The opaque dentin base shade OA-2 (Venus, Heraeus Kulzer) is placed in 1-2mm increments and cured to reduce polymerization stress on opposing walls. These layers are continued to the DEJ.

Figure 15 – A layer of T1, a translucent enamel shade (Venus, Heraeus Kulzer) serves as the final occlusal layer.

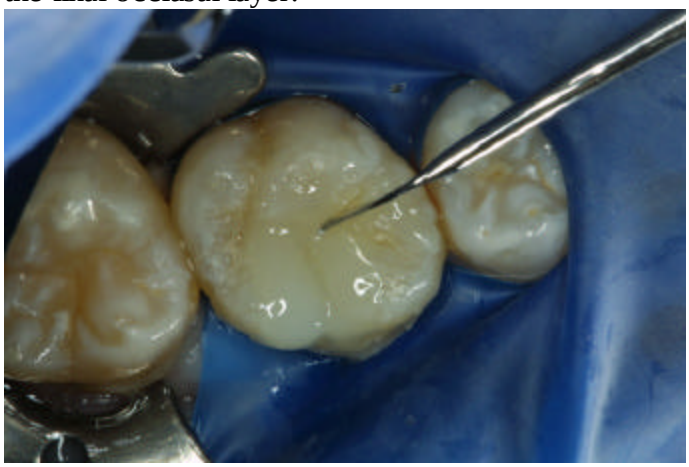

Figure 16 – The outer translucent layer is sculpted to blend with the existing anatomy to minimize the amount of post-operative finishing.

Figure 17 – The immediate post-operative result. Note the chameleon effect created by the outer translucent layer, creating a nearly seamless restoration.

Abstract

Though numerous tooth-colored indirect restorative materials are available in dentistry, practitioners frequently employ direct composite resins as a primary tooth colored restorative material. Direct resin systems that are suited for stratification, or layering of various opacities and colors of dental composite offer practitioners the opportunity to accurately reproduce natural teeth in ways that rival the esthetics of most indirect systems. This article will present a simplified version of the classical 3-layered technique originally described by Dietschi, and demonstrate the application of a recently introduced composite resin system.

Learning Objectives

After reading this article, the reader should be able to:

- ? Understand the basic principles of creating stratified, or layered composite restorations
- ? Understand the use of a preoperative wax-up and silicone stent to expedite the placement of anterior veneers
- ? Learn a technique for the application of resin tints for anterior characterization of direct resins
- ? Learn ways to minimize post operative complications in posterior composite placement

Quiz

1. The term "Classical 3-Layered" stratification technique was originally described by:
    a. Dr. Lorenzo Vanini
    b. Dr. Pascal Magne
    c. Dr. Ivo Krejci
    d. Dr. Didier Dietschi

2. When utilizing this simplified layering technique, highly opacious and chromogenic composite materials are used to:
    a. Provide vital incisal edge characterizations
    b. Replicate the optical characteristics of enamel
    c. Block out unwanted stains or the dark oral cavity in diastema closures
    d. Build the entire restoration in a single shade.

3. The popularity of utilizing direct composite resins is predicated on:
    a. The ability to place the restorations in a single visit.
    b. The ability to be used with conservative preparations.
    c. Their low cost of delivery compared to indirect procedures
    d. All of the above.

4. Which methods can be used to place resin tints in a direct composite restoration?
    a. Placed in pits or grooves in the surface of the restoration and covered with a highly translucent composite resin material
    b. Placed in pits or grooves and left uncovered, but finished with the bulk of the restoration.
    c. Placed under the opacious dentin layer.
    d. A and B only.

5. Which of the following is not an example of the information that can be transferred from a silicone stent created from a preoperative wax-up in an anterior diastema closure?
    a. Anatomy of the palatal wall
    b. Interproximal contours
    c. Dimensions of each tooth
    d. Facial contours

6. The placement of posterior composites in layers, or increments results in:
    a. The creation of a stratified restoration with more appeal esthetic depth.
    b. A restoration that produces less polymerization stress
    c. A restoration that may have fewer voids and better marginal seal
    d. All of the above

7. What is the primary advantage of using a translucent enamel shade as the final increment in a posterior composite?
    a. It facilitates the "chameleon" effect, drawing in color from the surrounding cavosurface margin, permitting a better color match.
    b. It increases the wear resistance of the restoration.
    c. It is less likely to stain over time.
    d. The lower elastic modulus of this material permits greater flexure upon chewing.

8. Finishing and polishing composite restorations should:
    a. Generate as much heat as possible to melt the outer surface of the composite for a "glazing" effect.
    b. Be done with diamond burs only.
    c. With a high speed handpiece.
    d. Should be done as efficiently as possible to minimize pulpal trauma

9. Utilizing a flowable composite as the initial increment, or liner in complex geometry posterior cavity preparations has which of the following benefits?
    a. Acts as an “elastic wall” to absorb the stress created during the polymerization contraction of the overlayed microhybrid.
    b. It’s rheology favors better adaptation to the irregularities of preparations.
    c. By reducing gaps created through fractures in the hybrid layer or the tooth itself, flowables can reduce microleakage and post-operative sensitivity.
    d. All of the above.

10. A diamond bur is recommended for abrading enamel when utilizing most self-etching systems.
    a. True
    b. False

The proliferation of esthetic materials and techniques was the hallmark of the end of the 20th century, and continues to epitomize the early 21st century in dentistry. It appears that the paradigm shift is complete, and the esthetics of a restorative service has moved beyond a secondary afterthought. Practitioners now have at their disposal a myriad of materials and techniques that not only restore the form and function of damaged tooth structure, but do so in a manner that is cognoscente of the esthetic demands of the patient.

While an abundance of indirect anterior and posterior materials have been developed in recent years, practitioners continue to seek and utilize directly placed composites on a frequent basis. The popularity of direct resins is predicated on the fact that they can be placed in a single visit in a conservative and affordable manner. By avoiding lab fees, provisionalization, and a secondary delivery appointment, direct composites prove to be an attractive option in appropriate clinical scenarios. In order to keep the cost of delivering esthetic direct composite restorations down, techniques and materials must be utilized that increase the efficiency in which the service is delivered, and decrease post operative complications..

The creation of stratified, or layered direct composite restorations are well documented in the literature.[1-6] Clinicians have long recognized the necessity to replace the various hard tissues removed during the restoration process with materials that replicate the hue, value, chroma, translucency, fluorescence and opalescence of natural teeth.[7-10] Modern layering concepts in direct composite placement are directly linked to the proper assessment of these qualities for the various layers of natural teeth, and not the tooth as a whole. As new, more sophisticated composite resin systems are developed, more attention is given to replicating the optical and color properties of both dentin and enamel. Gone are the days of simply using one shade of hybrid material to fill the entire class IV cavity. State-of-the-art composite systems today are designed to use at least 2 different opacity materials with entirely different optical properties to replace dentin and enamel separately, with the possible addition of colored tints or "effect" composites to emulate the polychromatic variances in natural teeth. Therefore, it is incumbent to the practitioner to understand at least the very basics of manipulating the various layers of a stratified direct restoration in order to elevate the his/her skills to this burgeoning standard of care.

The purpose of this article is to illustrate a simplified approach to creating stratified, layered direct restorations for both anterior and posterior applications using a newly developed microhybrid resin.

The Classical 3-Layered Concept

This classical 3-layered concept, as defined by Dietschi, relies on the application of two distinct masses of resin that coincide with the color and optical properties of dentin and enamel respectively.[6] Systems adapted to this concept typically have more opacious dentin body shades that are overlaid with a less chromagenic and more translucent enamel shade, both of which are typically based on the Vita (Vita Zahnfabrik) shade system. These two shades can be layered just short of the labial profile of the tooth,

and covered with a third, low chroma, highly translucent "incisal" material. Various resin tints can be applied under, or on top of this translucent shade to mimic the maverick colors often found in natural teeth. Current composite resin systems on the market today that employ this classical 3-layered concept are Herculite XRV (Kerr), Brillant (Coltene), and a recently released product, Venus by Heraeus Kulzer.

Venus is classified as a universal microhybrid composite material that is 61% filled by volume with ultra-fine filler particles which include radiopaque barium aluminum fluoride glass (0.7 – 2 microns) and highly dispersed silicon dioxide (0.01 – 0.04 microns). With a modulus of elasticity of 8,400 Mpa, flexural strength of 128 Mpa, compressive strength of 340 Mpa, and less than 75 microns of in-vitro wear after 1.2 million cycles, this system is suitable for both anterior and posterior applications. According to the manufacturer, one unique feature of this product is a "Color Adaptive Matrix," which described as optimizing the refractive indices of both the fillers and the resin matrix. By varying these indices, the manufacturer is able to produce 3 significantly different opacities which not only mimic the various optical properties found the layers of natural teeth, but utilize what is called the "chameleon effect" and draw in color from the surrounding tooth structure for seamless margins.[11] In keeping with the 3-layered concept, Venus comes in opaque dentin, enamel, and translucent shades and a unique shade guide that is made directly from the composite material for accurate shade matching.

Anterior Case Presentation:

A 22 year old male presents with the chief complaint of unwanted spaces between his anterior teeth. While orthodontics and porcelain veneers were given as treatment options, the patient was interested in the fastest, most economical way to address these concerns prior to his upcoming wedding. He was quite vocal about the fact that he was an avid Harley Davidson enthusiast and he enjoyed, and wanted to maintain, his "tough guy" look. He desired his new restorations to blend with his current shade, and be a natural extension of his existing smile.

Noteworthy in his preoperative condition was his excellent oral hygiene and lack of caries or restorations He had a generalized enamel hypoplasia with numerous maverick colors throughout his teeth. The base shade was calculated to be Vita A3.5, with interspersed shades of A2 and A1. Additionally, the teeth were disproportionate in size, with the lateral incisors appearing narrow compared to his central incisors and canines, **(Figures 1-2)**.

Treatment Recommendations:

To address the patients concerns for the most expeditious and economical treatment to close his diastemas, direct composite veneers were recommended on teeth 7 – 10. For this case, the Venus (Heraeus Kulzer) Opaque A 3.5 dentin shade was chosen as the base dentin shade. This opacious material would be brought to the surface in the highly saturated cervical 1/3 of the teeth and serve to block out the show-through of the darker oral cavity in the diastama area. This base shade would be layered, beginning in the middle 1/3 of the teeth, with the less saturated A2 and A1 enamel materials. The

secondary addition of white and brown/gold tints would be place under the final translucent shade primarily in the incisal 1/3 of the teeth.

Anterior Clinical Technique:

Preoperative diagnostic casts were made, and the models mounted on a semi-adjustable articulator (Stratos, Ivoclar/Williams). A preliminary wax-up correcting all size and shape discrepancies, as well as the closure of all diastemas was completed. Care was given to not alter the existing smile line, and the wax-up addressed the proper lingual and interproximal contours, midline orientation, incisal and gingival embrasures, edge position, and occlusion. A silicone index was then constructed by hand-mixing Optosil-Xantropen Comfort Putty (Heraeus Kulzer) with an appropriate amount of activator and adapting it directly to the wax-up. This index was then relined with Xantropen Medium viscosity tray material (Heraeus Kulzer) and reseated on the wax-up to capture the fine detail **(Figure 3)** as described by Vanini et al, stents of this nature serve several functions. First and foremost, it minimizes the chairside improvisation and subjective skill of the operator in achieving the proper anatomy of the palatal wall, the interproximal contours, contact points, dimensions of each tooth, the position of each tooth, and the distribution of the stratified layers.[5]

The teeth were prepared with conservative veneer preparations with light gingival chamfers and extension of these chamfers to the mesial/distal – lingual line angles where diastemas were present. The teeth were shortened approximately 1.5 mm to permit a sufficient thickness of the incisal edge for strength, and placement of the edges in the newly smile line. The teeth were then etched with Gluma Etch 20 (Heraeus Kulzer) for 20 seconds, rinsed and left moist. Multiple coats of Gluma Comfort Bond + Desensitizer were applied for 20 seconds, air thinned and cured with a halogen curing light (Optilux 500, Kerr/Sybron).

In order to expedite the placement process, the stratification of the various enamel and dentin layers on the lingual aspects of the teeth in the diastemas was eliminated, and the index was filled with only the opacious Venus OA3.5. The rationale behind such an approach was to forego the esthetics of the lingual aspect of the teeth, and utilize a material that would be opacious enough to block out the dark show-through of the oral cavity in these diastema areas. Once a sufficient amount of material was placed in the index, it was seated in the mouth, shaped and cured with a halogen light in boost mode (Optilux 500, Kerr/Sybron) for 30 seconds per tooth **(Figure 4).** The index was gently removed, the lingual aspect of the restorations inspected for flash or poorly adapted composite, adjusted, and cured from the lingual again. The teeth were separated by the use of gentle hand torquing, flossing, and use of an interproximal saw (Cerisaw, Denmat). Excess facial excess was then removed with a coarse diamond bur, and the teeth were thoroughly rinsed and dried.

Individually, the opacious dentin material was removed from the incisal edge, dead soft foil (Dead Soft Foil, Denmat) placed interproximally, and re-etched, and bonding agent applied and cured. The enamel shade A2 (Venus, Heraeus Kulzer) was applied to the gingival 1/3 and tapered into the middle 1/3 of the tooth **(Figure 5).** Slight horizontal depressions or grooves were intentionally left in the gingival marginal area to receive the application of white tint designed to replicate the hypoplastic bands found on

the adjacent teeth. The enamel shade A1 (Venus, Heraeus Kulzer) was blended into the A2 material at the middle 1/3, and sculpted to full contour. Prior to curing a thin composite instrument was used to create labial-lingual-incisal grooves in a "serrated" fashion to facilitate a zone of erratic translucency in the incisal 1/3 of the tooth. This layered was cured, and the process continued with the remaining teeth.

Once all four incisors were completed to this level, both white and brown/gold tints (Effect Color, Heraeus Kulzer) were placed in random areas within the serrated incisal grooves to mimic the maverick staining found in the surrounding natural dentition. White tints were applied in the grooves previously placed in the gingival 1/3 to mimic the hypoplastic white banding **(Figure 6).** The final phase of the placement process was to cover the incisal grooves and layered tints with a translucent incisal material, shade T1 (Venus, Heraeus Kulzer).

The teeth were then finished with coarse diamonds (ET Finishing and Polishing Kit, Brasseler), interproximal sanding strips (Softflex, 3M and Epitex, GC America). The high luster polish was achieved with a diamond impregnated silicone disc (Pogo, Dentsply/Caulk).

The 6 week post-operative result is demonstrated in **Figures 7 and 8**. Note the polychromatic result of the stratified veneers and appropriate integration with the existing dentition. The portrait in **Figure 9** depicts the patient in his preferred element, and the his new smile meeting his initial objectives of being an improved, but natural extension of his personality.

Stratified Posterior Applications:

The natural extension of layering or stratifying composites of varying opacity in posterior teeth is long standing. This technique not only offers highly esthetic results, but incrementally placing composites may relieve polymerization stress within the restoration, reduce postoperative sensitivity, and reduce microleakage.[12-15] Additionally, the use of lower elastic modulus material such as a flowable composite as the initial increment, or liner, may minimize polymerization forces that lead to microleakage. [16-18] By combining these techniques with the use of a self-etching resin adhesive system, ease of placement is enhanced, and the likelihood of post-operative sensitivity is minimized.[18,20]

Case Presentation:

A patient presents for the replacement of a failing amalgam restoration on tooth #3 **(Figure 10)**. The amalgam exhibited open margins and recurrent decay in the adjacent occluso-lingual groove. The decision to use a direct, stratified posterior composite was based on the patient' s desire for a tooth colored restoration, low decay rate, excellent oral hygiene, the minimal to moderate size of the defect, the fact that all margins would be in sound enamel, and the fact that the centric hold cusp was intact and much of the post-operative occlusion could be maintained on natural tooth structure. [21]

Posterior Clinical Technique

Local anesthetic was administered, and rubber damn isolation was achieved. The existing amalgam and recurrent decay was removed, and the final outline form of the restoration was established with a pear-shaped diamond bur (6830L, Brasseler). The pulpo-axial walls were rounded, and the cavosurface margins were placed at obtuse angles **(Figure 11).**

The adhesive chosen for this procedure was the newly released iBond (Heraeus Kulzer). The product is defined as a "7th" generation (a true single bottle, no mixing) self-etching system. According to the manufacturer, iBond is an unfilled, light curing, single component, no mix adhesive system indicated for direct anterior and posterior resins, with limited applications for indirect restorations. The matrix components include UDMA and 4-Meta, a well-established low pH (pH=2.2) bipolar primer suspended in acetone and water. The solvent for this system includes both acetone and water and the photoinitiator is camphorquinone. Noteworthy in this system is the inclusion of glutaraldehyde, a known disinfectant and desensitizer.[22]

In accordance to the directions for use, the preparation was refined with a diamond bur to facilitate a coarse finish on enamel. iBond was dispensed into a well, and multiple coats were applied over a 30 second period to dentin and enamel simultaneously. The pooled adhesive was thinned with oil-free air, and light cured with a halogen light (Optilux 501, Kerr/Demetron) for 20 seconds **(Figure 12).**

According to Utterbrink, Liebenberg, and others, the placement of a low elastic modulus material such as a lightly filled flowable composite as the initial lining increment in complex geometric cavity configurations serves two primary purposes. The favorable rheology of these materials permit better adaptation to the inherent irregularities of these preparations and serves as an "elastic wall" theoretically capable of absorbing the polymerization stress of the overlying, stiff hybrid composite. Both benefits may permit less contraction stress at the hybrid interface, leading to better marginal seal and less microleakage, particularly when the margins of the restoration are on sound enamel. [16-18] In this case, a thin layer of shade A-2 of Flowline (Heraeus Kulzer) was applied over the entire dentin surface, but kept shy of the DEJ, and light cured **(Figure 13).** Small increments of Venus microhybrid composite shade OA-2 were applied, first along non-connecting dentinal walls congruent to techniques advocated by Milicich and Rainey to minimize the polymerization stress, and cured. [23] This process was continued, allowing the remaining tooth structure to dictate the placement of grooves and cuspal inclines, but stopping approximately 1.5 to 2.0 mm from the cavosurface margins. This produces a low C-factor, class I cavity prep, in which a single, large increment of translucent incisal material can be added. The purpose of placing a clear incisal shade in this fashion is facilitate the "chameleon effect," which is the ability of these clear materials to draw in color from the surrounding natural tooth structure, allowing this top visible layer to blend seamlessly with the remaining tooth. In this case, shade T1 (Venus, Heraeus Kulzer) was applied and manipulated over the entire surface of the opaque layer, shaped to approximate final contour, and light cured **(Figures 15 and 16).** It is highly advantageous for clinicians to minimize the amount of finishing and polishing required by building posterior and anterior restorations to proper contour. Attention to this detail permits less rise in pulpal temperature caused by abusive finishing and polishing, saves time, and in many cases, leaves the bonded surface intact, which limits the need for any polishing at all. [24]

Once the restoration is meticulously built to the anticipated contour, the rubber damn is removed, minimal occlusal adjustments are made, and a simplified finishing procedure is accomplished with silicone points (Diacomp, Brasseler). The immediate post-operative result is picture in **Figure 17**. Note the virtually seamless margins, the blending of the color of the adjacent natural tooth structure with the restoration, and the anatomy dictated by the stratified, incremental placement procedure.

Conclusion

Stratifying, or incremental layering of direct composite is an effective way to not only achieve an excellent esthetic result, but serves to reduce polymerization stress and contraction gap formation which leads to post-operative complications. By utilizing the techniques and materials presented in this article, dentists are afforded an increased opportunity for clinical and esthetic success.

Bibliography

1. Magne P, Holz J. Stratification of composite restorations: systematic and durable replication of natural esthetics. Pract Periodon Aesthet Dent 1996; 8:61-68.
2. Dietschi D. Free-hand composite resin restorations; a key to anterior esthetics. Pract Periodon Aesthet Dent 1995; 7:15-25.
3. Dietschi D. Layering concepts in anterior composite restorations. J Adhes Dent 2001; 3(1): 71-80.
4. Fahl N, Denehy G, Jackson R. Protocol for predictable restoration of anterior teeth with composite resins. Pract Periodont Aesthet Dent. 1995;7:15.
5. Vanini L, De Simone F, Tammaro S. Indirect composite restorations in the anterior region: a predictable technique for complex cases. Pract Periodont Aesthet Dent. 1997; 9(7): 795-802.
6. Dietschi D. Layering concepts in anterior composite restorations. J Adhesive Dent. 2001; 3:71-80.
7. Vanini L. Light and color in anterior composite restorations. Pract Periodont Aesthet Dent 1996; 8:673-682
8. Winter R. Visualizing the natural dentition. J Esthet Dent. 1993; 5:103-117.
9. Muia P. The four-dimensional tooth color system. Carol Stream, Il: Quintessence Publishing, 1982.
10. Vanini L, Theunissen J. Development of esthetics in the anterior region. Contemporary composite applications. Journ Dent Symposia. 2002; Fall: 2-10.
11. Venus [product manual]. Armonk, NY: Heraeus Kulzer, Inc.
12. Krejci I, Stavridakis M. New perspectives on dentin adhesion – differing methods of bonding Pract Perio Aesthet Dent 2000; 12(8) 727-732.
13. Santini A, Plasschaert J, Mitchell S. Effect of Composite resin placement techniques on the microleakage of 2 self-etching dentin bonding agents. Amer Journ Dent 2001; 14(June): 132-136.
14. Carvalho R, Pereira J, Yoshiyam M, Pashley D. A review of polymerization contraction.: the influence of stress development verses stress relief. Oper Dent 1996; 21(1): 17-24.
15. Suh B, Wang Y. Determining the direction of shrinkage in dental composites by changes in surface contour for different bonding configurations. Am Journ Dent 2001; 13(2): 109-13.
16. Belli S, Inoksohi S, et al. The effect of additional enamel etching and a flowable composite to the interfacial integrity of class II adhesive composite restorations. Oper Dent 2001; 26(1): 70-75.
17. Malmstrom H, Schlueter M et al. Effect of thickness of flowable resins on marginal leakage in class II composite restorations. Oper Dent 2002; 27(4): 373-380
18. Unterbrink G, Liebenberg W. Flowable resin composites as “filled adhesives.” Literature review and clinical recommendations. Quintessence Int 1999. ; 30: 249-257.
19. Miyazaki M, Sato M, Onose R. Durability of enamel bond strength of simplified bonding systems Oper Dent 2000; 25(2): 75-80.

20. Kubo S, Yokota H, et al. Microleakage of self-etching primers after thermal and flexural load cycling. Amer Journ Dent 2001; 14(June): 163-169.
21. Liebenberg W. Assuring restorative integrity in extensive posterior resin composite restorations: Pushing the envelope. Quintessence Int 2000;31:44-50.
22. iBond [product manual]. Armonk, NY: Heraeus Kulzer, Inc.
23. Milicich G, Rainey T. Clincial presentation of stress distribution in teeth and the significance in operative dentistry. Pract Perio Aesthet Dent 2000; 12(7): 695-700.
24. Leni F. Facilitating reproduction of occlusal anatomy of posterior composite restorations. The mini-matrix. Pract Proc Aesthet Dent 2001;13(7): 539-544.