Diacrylic Composite Resins as Veneering Materials

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The development of resins represented a great step forward in dental technique, the first thermopolymerisable acrylic resins being developed in 1936. Due to their disadvantages, several new materials and their processing technologies, which promise better quality, were introduced on the market, among them diacrylic composite resins. Initially composites were elaborated as esthetic restorative materials, subsequently they developed very much, so nowadays are being used in many various fields of dentistry. Indications for diacrylic composite resins. (DCR) in dental technique include: esthetic veneering for mixed metal-polymeric fixed prosthetic restorations (FPR), unidental or temporary FPR, inlays, onlays, epitheses, repairing damaged porcelain veneers, artificial teeth, manufacturing the base of mobile and removable dentures, repairing and/or re-optimization of the mobile and removable dentures. The aim of this study is to bring into discussion the superior qualities of the the new generation, VITA VM LC (VITA) composite veneering resins. The laboratory steps to be followed in order to obtain a VITA VM LC veneered FPR are the usual ones. After completing the metallic frame, the following step is veneering with VITA VM LC. The VITA VM LC layering concept is oriented after the natural model and is clearly distinguishable from all the other stratification concepts. The natural fluorescence and opalescence reproduction possibility leads to individual results with an aesthetically impressive appearance. A layered restoration performed with VITA VM LC behaves like a natural tooth in different lighting conditions. The excellence in dentistry is often achieved by combining scientific principles with artistic creativity, while choosing the material and technique has a major importance.

Keywords: diacrylic composite resin for veneering, VITA VM LC, layering concept, aesthetic results

In dentistry, non metallic materials for dentures manufacturing have a long tradition.

Among the first used materials there were wood, ivory, hippopotamus teeth dentin or even human teeth. Due to the prohibitive price, only the rich ones could enjoy the luxury of such dentures. Discovery of vulcanized rubber by Charles Goodyear in 1839, was the premise of achieving the first dentures with the base made of this material, thus becoming accessible to any pocket [1]. In 1871 the celluloid emerged and it was the first artificial polymer competing the rubber, but not being able to overthrow it due to the dimensional instability, deformability and awkward processing technology. Resins represented a major step forward in dentistry, the first acrylic thermo-polymerizable resins coming up in 1936 [2]. Acrylic resins dominated dentures technology for several decades, being used for denture bases, artificial teeth, veneering materials and unidental restorations.

Due to their disadvantages, such as the toxicity of the residual monomer (organic solvent, hepatotoxic), the awkward wrapping system, difficult processing, on the market new materials together with their processing technologies, which promise better quality [2] constantly appear: diacrylic, styrene, polycarbonate, epiminic, polyurethane, vinyl, polyamides, acetylic resins, polyglass.

The event that marked the beginning of diacrylic resins era in dentistry was the appearance of aromatic dimetacrylate Bis-GMA, $C_{29}H_{36}O_8$, known as Bowen's resin (fig. 1).

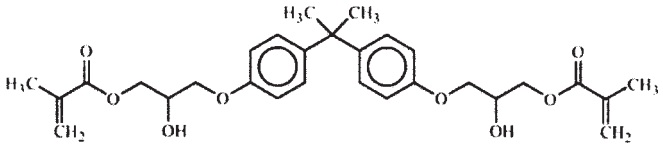

Fig. 1 Bisfenolglicidilmetacrylate (Bis-GMA)

Diacrylic composite resins are triphasic systems, consisting of an organic phase (continuous), inorganic phase (discontinuous) - filling and silane coupling agents, at which the initiator is added. The organic phase of the composite resins consists of a mixture of monomers containing bisfenolglicidilmetacrylate (Bis-GMA), trietylenglycoldimetacrylate (TEGDMA), uretandi-metacrylate (UDMA) in various combinations, more recently bisfenolpolyetilenglycoldieterdimetacrylate (Bis-EMA) being introduced, with the role of reducing the shrinkage contraction. The filler particles determine the handling characteristics, reduce contraction and abrasion capacity and hardness increasing. They include amorphous silica, quartz, radiopaque glass (barium, strontium), zirconium and fluorosilicates. The filler particles are associated by the silane coupling agents, for them to adhere to the matrix resin. The most used silane coupling agent is metacryloxipropyltrimetoxisilane [3].

Polymerization can be initiated chemically by mixing the two components, of which one contains the initiator and one the activator, usually peroxide 1% as initiator and tertiary amine 0.5% as activator. In case of light-curing resins, the initiator substance, usually a mixture of camforchinone and amine, activates the polymerization of the resin by exposure to visible light (460-480nm) [3].

Composites were initially elaborated as esthetic restorative materials, then had a great development, nowadays being used in various fields of dentistry.

Indications for diacrylic composite resins (DCR) in dental technique include: esthetic veneering for mixed metal-polymeric FPR, unidental or temporary FPR, inlays, onlays, epitheses, repairing damaged porcelain veneers, artificial teeth, manufacturing the base of removable dentures, repairing and/or re-optimization of removable dentures [4].

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Compared to acrylics, DCR have a lower shrinkage during polymerization and higher, net superior levels of physico-mechanical and chemical resistance. Light-curing materials have the advantage of prolonged handling time. In addition, they physico-chemically adhere to the metallic frame, have good color stability in time and a special esthetic effect and can be easily repaired in the oral cavity. Compared to the classic ceramic materials, they do not cause abrasion veneers on the natural antagonists, but fail to achieve the aesthetic performance and color stability of ceramics.

DCR can be auto-, thermo or photo-polymerizable. Light-curing diacrylic resins are successfully used in dental labs. For indirect restorations hybrid composites are suitable, due to their higher resistance and good colour stability. The adaptation is excellent and their structure is resilient, allowing to obtain beautiful and functional restorations, offering at the same time the possibility to preserve as much of the hard dental structures as possible. They are indicated for manufacturing of FPR and veneering metallic frame.

The autophotopolymerizable resins (dual cure) were launched on the market to counteract the disadvantages of each singular initiation system. The initial cure begins immediately after mixing the two components, at this stage the material in elastic state, being able to be processed using a scalpel, scissors or even rotary instruments. The final polymerization is undergoing under the action of light, emitted by the photo lamp. There are diacrylic thermo-polymerizable or photo/thermo-polymerizable resins also, for total esthetic prosthetic restorations with or without metallic support. The aesthetic effect achieved is very good because of the identical to enamel luster and natural opalescence of the material. Composites with polymerization under pressure and heat also exist, the finished product having a smooth surface, with a similar to ceramics abrasion resistance. The physiognomic effect also is very good.

Aim of the study

The aim of this study is to bring into discussion the superior qualities of the new generation VITA VM LC (VITA) composite veneering resins, which, in terms of aesthetic, are equal with the dental ceramic (fig. 2).

Fig. 2. Curing composite diacrylic resin VITA VM LC (VITA)

Experimental part

We have chosen VITA VM LC (VITA) because VITA leads the way internationally in dental materials related to tooth shading. VITA Zahnfabrik H. Rauter GmbH & Co. KG (abbreviated as "VITA") is a German family-run dental technology company, founded in 1930, with a long history that offers a wide range of products and systems for both dental practices and dental laboratories. The name VITA (from the Latin term vita meaning "life") reflects the company's objective of creating products that are as natural and "lifelike" in appearance as natural dentition itself [5]. Today, VITA offers a wide range of materials for almost any indication or technique. All VITA materials are perfectly tailored to one another and available for the entire spectrum of dental and dental technology applications. Using VITA shade guides and digital shade-taking devices, all tooth shades can be accurately determined to allow for reliable subsequent reproduction. The first uniform shade standard, VITAPAN classical A1–D4 was introduced in 1983. The VITA SYSTEM 3D-MASTER launched in 1998 is considered the most reliable shade determination system in the world as well as dentistry's gold standard. It enables flawless collaboration between dentists and dental technicians and offers complete coverage of the entire tooth color space. Determination of the tooth shade was further simplified with the introduction of VITA Easyshade in 2008, allowing dentists to reliably determine and verify all tooth shades in a matter of seconds using digital technology [5].

The composite chosen by us, VITA VM LC was introduced in 2003 together with the VITA VM veneering concept for ceramics and resins.

VITA VM LC is indicated for: full and partial veneering of crowns, bridges, over dentures, implant suprastructures, veneering of acrylic substructures, inlays, veneers, metal-free crowns and three-unit anterior bridges as long-term temporaries, layering over long-term temporaries made of VITA CAD-Temp, individualization of VITA acrylic teeth [6].

The laboratory steps to be followed in order to obtain a VITA VM LC veneered FPR are the usual ones: model casting using class IV plaster (extrahard), pins application, casting of the model base using class III plaster (hard), finishing the model base, abutment cutting and wax pattern modeling (fig. 3). Modeling the wax pattern for the metallic frame is done in a different way for partially esthetic FPR compared to the totally esthetic ones. Macro-retentions were applied, then the pattern was invested (fig. 4), after carrying out the specific preliminary phases (rod and casting cone application, making the shrinkage ball, stress relief, degreasing etc.). After removing the wax from the investment, the metallic frame was casted, followed by deflasking, processing and polishing (fig. 5).

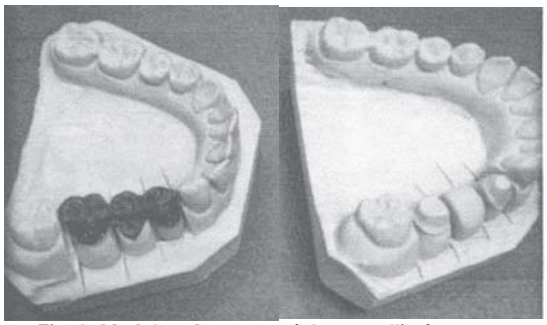

Fig. 3. Model and pattern of the metallic frame

The next stage is represented by the VITA VM LC esthetic veneering, which begins with the application of the opaque layer. Pre opaque enhances adhesion for metal frameworks, perfectly hardens even with little light and enables an even opaquer layer.

The opaque paste enables an accelerated processing, fast polymerization and perfect framework coverage. Its homogeneous viscoelastic consistency makes application very user friendly: It spreads easily when applied and ensures optimal stability on edges as well as on retentions [5]. After polymerization, VITA VM LC OPAQUE must have a lustreless, dry and silky surface (fig. 6).

VITA VM LC can be built up over metal and resin frameworks and is indicated for veneering of full and partial

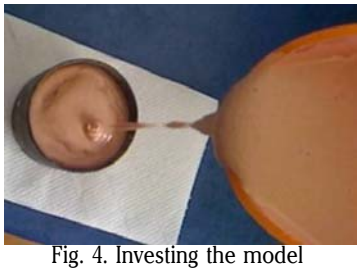
Fig. 4. Investing the model


Fig. 5. The metallic frame

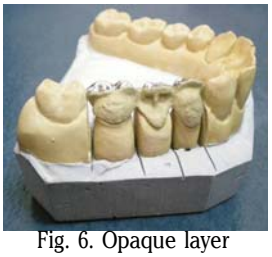
Fig. 6. Opaque layer


Fig. 7. Light-curing

crowns, bridges, inlays, and onlays. It can be used to individualize all VITA denture teeth. For accurate shade taking and reproduction, VITA VM LC is available in 3D-Master and Classical shades. Two shade systems for accurate shade-taking and shade reproduction are available: VITA SYSTEM 3D-MASTER and 10 VITA classical A-D shades. New shades as A4, B2, C2, C3 and effect enamel EE2 for yellowish- white incisal areas are now available [5].

The VITA VM LC layering concept is oriented after the natural model and is clearly distinguishable from all the other stratification concepts. The VITA VM BASIC layering, with intense chromatics, consists of two layers: base dentin and enamel and, due to the chromophore base dentin layer, is especially suitable for tooth color reproduction at low walls thickness. With only two layers a restoration natural glow and appearance can be achieved.

The translucent VITA VM BUILD-UP layering uses three components: base dentin, transparent dentin and enamel. Harmonization between the base dentin layer and translucid transpa dentine provides a depth effect that confer natural aspect. Reproduction of the natural fluorescence and opalescence is achieved by using additional masses which leads to individual results with an impressive esthetic appearance.

VITA VM pigments can provide a fluorescent look to restorations. VITA VM opal effect masses were created specifically to give translucency, which is characteristic for young teeth. The opalescent VITA VM frit contains a rich palette of colors corresponding to the natural teeth. VITA VM LC polymerization is performed with lamps which emit light with wavelengths from 350nm to 500nm. Polymerization occurs more rapidly at elevated temperatures, a temperature between 60-80°C contributes to a rapid and accurate polymerization (fig. 7).

Insufficient polymerization of composites, because of old or inappropriate lamps can lead to defects. Lack of mechanical stability and poor quality of the resulted surface leads to peeling and secondary discoloration of the esthetic component. In case of light-curing resins, the polymerization results depend on the quality of equipment used. Intermediate light-curing can be performed at any time during stratification. For a complete curing of the larger structures, further polymerization of the interdental spaces is necessary. If during the material stratification or if after polymerization corrections are needed, tungsten carbide burs with fine cut can be used. For completion, the desired material can be applied on the surface, cleaned and moistened with modeling liquid. Finishing is carried out with tungsten carbide burs with fine cut, at a speed of 15.000 rpm. Polishing is done using a suitable silicone rubber and a small natural hair brush, with polishing paste, being cautious to avoid heat generation, which could affect the composite. Polishing is the final laboratory phase, the FPR following to be fixed in the oral cavity (fig. 8).

Fig. 8. FRP plated with VITA VM LC

Results and discussions

In order to achieve a quality FPR a multitude of parameters like: smile appearance, color, position, tooth shape and texture, pursued aesthetic objectives etc. should be considered. Depending on all parameters considered, the type of restoration is selected and the material selection is made.

The new and improved VITA VM LC enables unlimited creativity for any indication, so that you can achieve esthetic restoration results that are virtually indistinguishable from those of ceramics. Available with paste opaquers and additional new shades, Vident's VITA VM LC offers shade stability and high plaque resistance and are the guarantee of quality [5].

Refraction and reflection behaviour is similar to that of dental enamel. A layered restoration performed with VITA VM LC behaves like a natural tooth in different lighting conditions. Due to the homogeneous surface, the veneering material is very smooth to the touch, contact with tongue being similar to the natural teeth, so that the FPR will be very easily tolerated by the patient.

Conclusions

Diacrylic composite resins are complex materials. The excellency in dentistry is often achieved by combining scientific principles with artistic creativity, while the optimal choice of material and technique have a major importance.

VITA is considered a pioneer in the field of dentistry [7]. VITA materials form part of an integrated system and are available in all natural tooth shades. This is also true of all-ceramics, metal ceramics and acrylics, making VITA a one-stop shop for all dental materials and for all tooth shades [5].

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Polimerizări ionice şi ionic coordinative

Autor: Prof.dr.ing. Gheorghe Hubca
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Bucureşti

*Lucrarea "**Polimerizări ionice si ionic coordinative**" prezintă cele mai noi şi mai moderne procedee de polimerizare, care conduc la compuşi macromoleculari cu arhitectură controlată şi proprietăţi unice.*

În capitolul I se realizează o comparaţie între polimerizarea radicalică şi polimerizarea ionică, scoţându-se în evidenţă caracteristicile şi avantajele proceselor ce decurg prin mecanism anionic şi cationic.

Capitolul II tratează cele mai semnificative aspecte privind polimerizarea anionică: natura monomerilor capabili să polimerizeze prin mecanism anionic, sistemele de iniţiere, mecanismul şi cinetica procesului, copolimerizarea anionică.

Capitolul III este dedicat polimerizării cu transfer de grupă, metodă ce permite obţinerea polimerilor "vii" la temperatura camerei, iar capitolul IV polimerizării cationice. Se prezintă monomerii capabili să polimerizeze prin mecanism cationic, chimismul, mecanismul şi cinetica reacţiilor de polimerizare.

Capitolul V prezintă mecanismul şi cinetica proceselor de polimerizare ce decurg prin intermediul catalizatorilor Ziegler-Natta. Se prezintă comparativ performanţele catalizatorilor Ziegler-Natta din generaţiile V şi VI cu cele ale sistemelor clasice din prima generaţie.

Capitolul VI este dedicat aspectelor legate de polimerizarea olefinelor cu catalizatori metaloceni (catalizatori Kaminski) iar capitolul VII prezintă performanţele catalizatorilor postmetaloceni.

Capitolul VIII se referă la una dintre cele mai fascinante metode de sinteză a polimerilor şi anume metateza cicloolefinelor. Se prezintă critic aspecte legate de chimismul şi cinetica reacţiei de metateză, precum şi date referitoare la copolimerizarea cicloolefinelor.

Fiecare capitol se încheie cu aplicaţii industriale ale procedeelor de sinteză prezentate.

Lucrarea se adresează în principal studenţilor facultăţii de Chimie Aplicată şi Ştiinţa Materialelor, inginerilor ce urmează cursurile de master şi doctoranzilor, dar considerăm că este utilă şi specialiştilor ce lucrează în cercetare, proiectare sau producţie.

Prof. dr. ing. Horia Iovu