Current Oral Health Reports
https://doi.org/10.1007/s40496-023-00351-2

Introduction of a New Classification for Resin Composites with Enhanced Color Adjustment Potential

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Accepted: 8 September 2023

Abstract

Purpose of Review With the introduction of new resin-based composites (RBC) based on their adjusted shade properties, there is a need for an additional classification for such materials. This review discusses and suggests a new classification for the RBCs.

Recent Findings The classification of RBCs depends on different compositions and characteristics such as inorganic filler type, shape and size, resin matrix, polymerization modes, level of viscosity, clinical application protocol, and indications. The classification is generally focused on the filler size, filler type, and composition. Recently, some manufacturers have created contemporary esthetic RBC kits with enhanced color adjustment potentials. This ability is considered very specific and particularly depends on the shade and the brand of the selected composite kit. The current RBC classifications are generally inadequate in describing the shade-matching abilities of these new materials.

Summary An additional universal terminology and related classification are required, describing the level of color adjustment potential of contemporary RBCs. The suggested new classification divides RBCs as 'polyshade,' 'simplyshade,' and 'monoshade universal.'

Keywords Monoshade universal · Simplyshade · Polyshade · Resin composite · Color adjustment

Introduction

Resin-based composites (RBCs) have been widely used as one of the most common restorative materials in clinical applications for nearly 50 years [1•]. Since the first introduction of successful synthesis by adding an organic monomer and inorganic fillers [2], composites have been improved regarding the formulations, properties, and esthetics [1•]. A composite is defined as a mixture of hard inorganic particles bound together in a resin matrix [3].

The resin-based matrix is most generally composed of bisphenol A-glycidyl methacrylate (Bis-GMA), triethylene glycol dimethacrylate (TEGDMA), hydroxyethylmethacrylate (HEMA), and urethane dimethacrylate (UDMA). Inorganic fillers generally include ceramic fillers and glass powders such as silica and quartz, which may increase resistance to wear, surface micro-hardness, and translucency of the material [4]. An organic silane such as 3-methacryloxypropyltrimethoxysilane or 10-methacryloyloxydecyl dihydrogen phosphate (10-MDP) is generally included as a coupling agent to enhance the bonding strength between the resin matrix and the filler [5]. Photo-polymerization of the RBC is generated by an initiator system, generally such as camphorquinone (CQ) or phenylpropanedione (PPD), through various levels of light or heat energy. The catalyst is the controller of the polymerization speed. Some constituents such as dimethyl-glyoxime are used to improve the physical properties like the level of flowability [6]. However, the organic matrix was generally neglected in the classification of RBCs.

Today, the classification of RBCs depends on different compositions and performance characteristics such as the following: (1) the inorganic filler particle size of the composite, (2) the inorganic filler particle type, (3) the curing mode of the resin, (4) the restorative procedure, (5) level of viscosity, and (6) functional capability of the material [1•,

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7]. However, it is clear that the classification has mostly focused on the filler size and filler type/composition [8, 9].

The Current Classification of RBCs

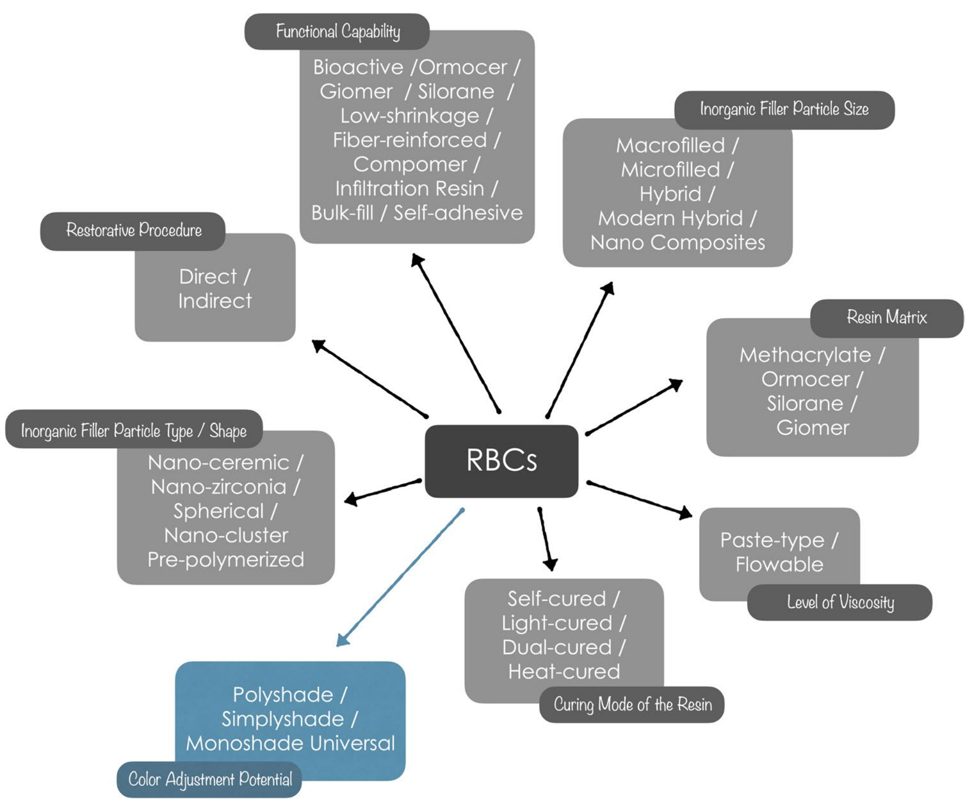
Inorganic Filler Particle Size

One of the most common classification systems considers the average inorganic filler particle size, shape, and distribution [7, 10] (Fig. 1). Lutz and Phillips presented macrofilled, microfilled, hybrids, and modern hybrids in 1983 [11], and Bayne et al. added the nanofilled composites as subdivisions in 1994 [12]. The macrofilled composites were mechanically strong with particle sizes ranging from ~ 10 to 50 µm, but polishability and color stability were major clinical problems. Then, microfill composites were introduced with particle sizes ranging from ~ 40 to 50 µm, which were considered more esthetic but not good at resistance to fracture and wear properties. As a result, materials with significantly reduced particle size were introduced and called hybrid composites [1•]. Although hybrid composites were considered the best materials for posterior restorations at first, up-to-date, modern hybrid composites including particle sizes ranging from ~ 0.5 to 1.0 µm and ~ 10 to 50 µm were also defined as very useful for anterior esthetic restorations due to the relatively high optical properties and variety of different color options [13]. Some manufacturers also have used the term sub-micron (~ 0.5–1.0 µm) for the composites [8, 14]. However, the improvement related to the fillers has continued to improve especially the esthetic qualities of the resin-based materials. Finally, with the help of nanotechnology, composites with nanosized fillers were introduced including particle sizes ranging from ~ 10 to 100 nm [8, 14]. The increase in filler loading results in a decrease in the amount of resin matrix. Therefore, it became possible to produce esthetic and clinically long-lasting RBCs (nanohybrid and nanofill) with significantly improved depth of cure, resulting in reduced levels of polymerization shrinkage [1•]. Accordingly, some manufacturers have also used supra nanohybrid (~ 200–260 nm) term, to get their material included in the nanosized category, most probably for the marketing issues.

Inorganic Filler Particle Type/Shape

Another common classification system considers the inorganic filler particle filler type or composition [8] (Fig. 1). A classification based on filler size may not reflect the type, morphology, composition, or other specificities (geometry, surface coating, etc.) of the inorganic filler [8, 15]. For instance, all nanohybrid resins may not display the same properties and therefore remain controversial. Consequently, some researchers have classified the RBCs according to the type or composition of the inorganic fillers such

Fig. 1 The modified classification of RBCs



as nanoceramics, nanozirconia, nanocluster, and spherical. Pre-polymerized particles were also added in some materials to reduce the polymerization shrinkage and to provide a better polishability [8].

Resin Matrix

The first produced direct composites consisted of silicate cement and methyl methacrylate without any filler. Adhesive epoxy resins have been used to bond large numbers of small silica particles, but the slow polymerization of epoxy formulations has resulted in the synthesis of Bis−GMA [16]. The process, which started with the synthesis of a new monomer called Bis−GMA in 1956, continued in 1962 with the addition of TEGDMA, a co−monomer to reduce the viscosity and assist the incorporation of filler particles. Until the mid−1990s, 80–90% of the composites in the market contained Bis−GMA and the other monomers were TEGDMA, UDMA, and bisphenol A−ethoxylated dimethacrylate (Bis−EMA) [17]. In the 1990s and 2000s, formulations such as oxymethacrylate, highly branched methacrylates, thiolene methacrylate systems, cyclic siloxane monomers, open ring molecules, and modifications of organic resin were tried to reduce polymerization shrinkage and stress. As a result, low−shrinkage composites were introduced [18]. One of the modifications in the monomer system was the use of ring−opening monomers resulted in the development of silorane−based RBC (Siloran, 3 M, USA) with low polymerization shrinkage. Siloran is a combination of siloxanes and oxiranes that creates a unique chemical structure with hydrophobicity [19]. The term ‘Ormocer’ was derived from ‘organically modified ceramic’ and is described as three−dimensional cross−linked co−polymers that tend to overcome the problems regarding the polymerization shrinkage of conventional composites. The coefficient of thermal expansion of Ormocer is similar to the natural tooth [20, 21]. Admira and Admira Fusion (Voco GmbH, Cuxhaven, US) are the examples of Ormocers in the market. Glass ionomer + polymer are pre-reacted glass ionomer-filled (pre-reacted glass filler (PRG)) composites and tooth-colored hybrid restorative materials, developed by combining the optical properties of resins [22, 23]. Giomers produced with fully reacted glass filler (F-PRG) technology containing fully reacted glass fillers are known as Reactmer (Shofu Inc., Kyoto, Japan). Giomers produced with surface reacted glass filler (S-PRG) technology containing surface reacted glass fillers are known by the generic name, Beautifil (Shofu Inc.) [24].

Curing Mode of the Resin

Some researchers have classified RBCs according to the polymerization initiation systems or curing mechanisms [1•] (Fig. 1). Accordingly, the composites were divided into four subdivisions as self-cured, light-cured, heat-cured, and dual-cured composites [25]. Powder–liquid or paste–paste materials are mixed for the self-cured composites to initiate polymerization. However, these types of composites are generally used as core materials or resin-based luting cements now [25]. The light-cured composites use visible light or ultraviolet (UV) to initiate the polymerization reaction. These materials are the most frequently preferred RBCs in dental clinics today. Blue light curing units are generally used for this purpose in dental clinics with a wavelength ranging from 385 to 515 nm. Diphenyl (2,4,6-trimethylbenzoyl) phosphine oxide (TPO), camphorquinone (CQ), or benzoyl germanium (IvocerinTM) are the photoinitiators involved in dental RBCs to start the blue-light polymerization [26], whereas TPO and Ivocerin are better activated by using violet light (385 to 420 nm). Accordingly, some light curing units are polywave, emitting both blue and violet wavelengths [25]. Heat-cured composites are polymerized by additional heat application. Dual-cured composites have multiple curing modes and are polymerized by the combination of various initiation systems to form polymers. They are generally composed of two pastes (a catalyst and a base), similar to the self-cure composites, but their base paste contains the CQ/amine photoinitiation system for visible light activation, in addition to an amine co-initiator for chemical (self-) polymerization. The chemical (self-) polymerization starts when the two components are mixed, and the material can be light cured at any time during the chemical polymerization period [26]. These materials are useful for the cementation of endodontic posts and core build-ups [1•].

Restorative Procedure

In terms of the selected restorative procedure, the type of RBCs is divided into two as direct and indirect composite materials [1•] (Fig. 1). Direct composites are preferred for the direct restorative layering techniques while indirect composites are cured pre-restoratively, generally in a laboratory, and cemented indirectly [27]. The indirect composites were introduced by Touati and Mörmann for posterior onlays and inlays in the 1980s, offering a more stable alternative for extensive restorations [1•, 28].

Level of Viscosity

Paste-type composites and flowable composites have been used for both anterior and posterior restorations for years. With the greater level of wettability, the flowable composites were considered useful materials for dental procedures since their first appearance in 1996, such as adhesive cementation material, cavity liner, immediate dentin sealing (IDS) material, and fissure sealant agents [1•]. However, the polymerization shrinkage of these low-viscosity materials was higher than the conventional composites and the filler load (37–53% vol) was not great enough to be left at the outer surface layers of the restorations due to their weak mechanical properties and low polishability [1•, 29, 30]. Accordingly, some researchers and clinicians have used pre-heated paste-type composites to obtain the advantages of the flowable composites and the paste-type composites at the same time. Recently, in order to merge the advantages of flowable and conventional composites, highly filled (≥ 70% vol) flowable composites were introduced as an alternative to conventional paste-type composites for both anterior and posterior restorations [1•, 30] (Fig. 1).

Functional Capability

In addition to the previously mentioned classification, there are different RBC materials in the market with some unique specifications (Fig. 1). *Fiber-reinforced composites* are one of the most effective composite materials to support the remaining tooth structure in large restorative cavities [1•]. The most famous fiber-reinforced material in the market is Ever-X Posterior (GC Corp. Japan), and it has paste-type and flowable versions including short fibers. *Compomers* refer to polyacid-modified resin-based composites representing the combination of composite and glass ionomer cement. It has the ability to release fluoride [1•]. However, they also face several issues such as brittleness, low strength, long curing time, and water sensitivity, which have limited their applications. *Infiltration resin* is a low-filled flowable resin which is also known as ICON (DMG, Germany) in the market, used for the restoration of hypo-mineralizations and 'white-spot' lesions in vestibular and interproximal surfaces within the concept of minimally invasive approach. This resin can infiltrate the inter-crystalline spaces by capillary action [31]. *Bulk-fill resin composites* are restorative materials that allow incremental layering up to 4 mm in thickness. The higher color translucency and innovative initiator systems are responsible for that advantage [32]. These materials have both paste-type and flowable types. *Self-adhesive composite* involves the benefits of the adhesive agent and the resin composite. No separate adhesive agent is required for these materials [33]. Venus Diamond, Venus Pearl, and Charisma Topaz composites (Kulzer, Hanau, Germany) contain a novel monomer, the bis-(acryloyloxymethyl) tricycle-[5.2.1.02,6] decane-TCD-DI-HEA, which is a *low-shrinkage* methacrylate monomer with low viscosity, increased mechanical performance and improved biocompatibility. It has three connected rings in its structure that may induce slow curing [21, 34]. The *in vitro* data for these different monomers show promising results, with significantly lower shrinkage levels compared with those obtained with bis-GMA RBC derivatives and often with improvements in mechanical properties [17]. The term bioactive refers to the ability of a material to form hydroxyapatite crystals on the surface (Bioactiva, Activa Presto; Pulpdent, USA).

Apart from all these classifications, there is a need for an additional division, regarding the shades of the resin-based composite material kits. This review mainly discusses and suggests a new classification for the RBCs. Most recently, some manufacturers have developed the optical properties of their resin composites to enhance the esthetic outcome and to inhibit the possible problems related to the color adjustment. Accordingly, contemporary RBCs gained the ability to match their color to the surrounding dental tissues/tooth cavities. This phenomenon is called the "chameleon effect" and was first mentioned in a scientific paper in 1991 [35]. In 2006, the color blending between the restoration and the surrounding dental tissues was named the "blending effect" by Paravina et al. [36, 37•, 38••]. The same researchers introduced the "color adjustment" term for this phenomenon later in 2008 [37•]. The term "color shifting" was also mentioned by several researchers previously [39–41] while "color adjustment" is generally the most recent and preferred term in literature regarding that topic [42–46].

In restorative dentistry, the color match between the RBC material and the adjacent natural dental tissue should be at optimum level in order to provide an esthetically pleasing outcome. In other words, the color difference between these two should not be detected by the human eye [47••]. Therefore, in terms of the esthetic view, the selection of RBC does not depend on only the mechanical properties but also its optical properties such as color adjustment ability, masking ability, translucency, and color stability [47••]. Ismail and Paravina described three main factors (related to resin composite, cavity preparation, and substrate surrounding the restoration) affecting the color adjustment potential of RBCs in 2022 [47••]. According to the authors, the factors related to the resin composite depend on the brand, shade, and translucency of the material, apart from the filler size and content.

However, the current description lacks the factors related to the selected restorative procedure. Accordingly, the potential factors related to the layering technique, finishing technique, and surface morphology should also be considered when deciding the color adjustment potential of RBC restorations as these factors may also influence the final color of the restorations. Besides the opacity and translucency of the selected RBC shade, the final color of restoration is influenced by the thickness of the applied layers of the shade. As the thickness of the layers of an opaque shade (dentin or body shade) increases, the opacity of the restoration increases. Whereas, as the thickness of the layers of a translucent shade (enamel shade) decreases, the opacity of the restoration decreases and may result in a greyish color due to the dark oral cavity. Therefore, the monochromatic layering technique including only a single shade layering and the polychromatic layering technique including layering of at least two shades generally in different opacities are both prone to affect the final color of the restoration in terms of the layering thicknesses of the selected shades. Additionally, the thickness of the final surface layer can be altered through the selected finishing protocol. In terms of the 'additive layering technique,' a clinician spends most of the time on the layering part without generating over contours on the final surface of the restoration. Thus, as long as the proper layer thicknesses are provided, the final shade of the restoration is relatively more predictable. On the other hand, in the 'subtractive layering technique,' the clinician generates over contours on the surface of the restoration and spends most of the time subtracting those with finishing instruments such as burs. This procedure has the risk of altering the thickness of the surface layer, resulting in potentially changing the opacity/translucency and the masking ability of the restoration. Working at a 12 o'clock position under magnification with high-quality lightning can be useful to avoid over-preparation. Moreover, it was considered that the final color of the restoration can be influenced by the surface structure/morphology as it affects the value (the amount of light reflected from the surface) parameter. Following generating a natural-like surface morphology, the light reflects from the hills and grooves of the surface of a restoration in a different way resulting in altering the value as well as the precepted final color of the restoration. On behalf of the information mentioned above, the figure regarding the color adjustment potential can be modified to include the factors related to the restorative procedure (Fig. 2).

The level of color adjustment depends on several parameters as previously mentioned. Because of this multifactorial issue, clinicians demand resin-based materials with enhanced optical properties that can spontaneously inhibit possible mistakes during restorative procedures [46]. The increasing high esthetic demands have led the majority of manufacturers to produce contemporary esthetic RBC kits with the ability of color adjustment [48•]. Accordingly, the composites are generally in different shades with varying degrees of translucency in the market now [49]. The pigment content is considered a trade secret for many brands and is not mentioned by the manufacturers [47••]. As a result, the color adjustment potential of the RBCs is considered very specific and particularly depends on the shade and the brand of each composite kit [38••, 46]. As RBCs have become ever more versatile, innovations that bring significant changes in terms of material application should lead to an update [9]. Remembering the fact that a practitioner may only see the color and feel the handling of an RBC, lacking a terminology for classifying and comparing the composites with various optical specifications, may cause confusion in the selection of the material and the description as well. The current classifications and terminology are obviously not enough to compare such innovative and distinguishing optical properties. Therefore, a new specific universal language is needed when comparing these restorative materials, such as "X shade from Y brand provides a better color adjustment than X shade from Z brand" [47••]. Moreover, additional terminology particularly describing the level of color adjustment potential of the RBCs and a related new classification is required to serve as a simple guide to material selection in clinical applications as well as in scientific studies. The new classification including the suggested modification is presented in Fig. 1.

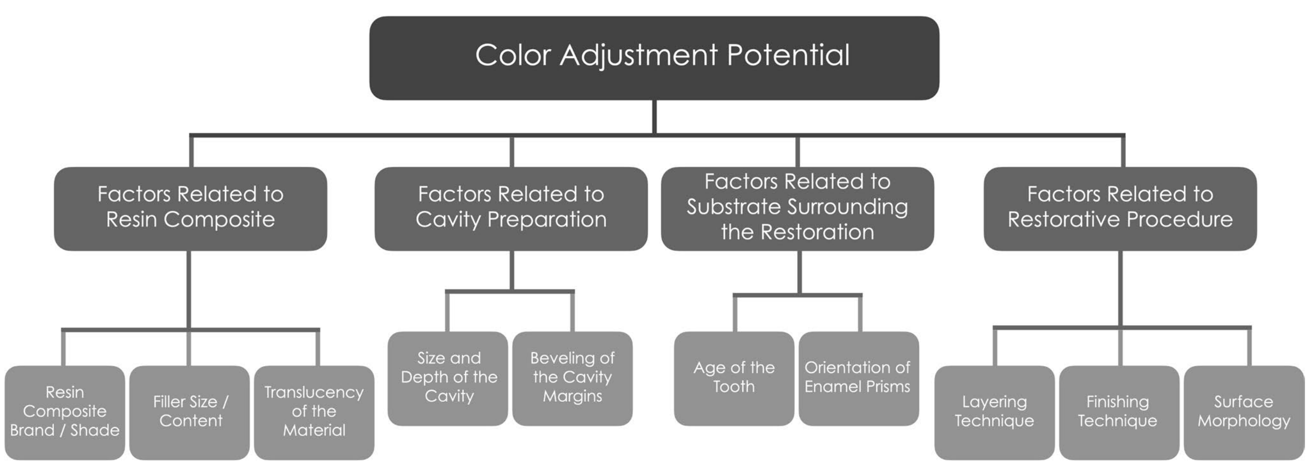


Fig. 2 The modified classification for the factors related to the color adjustment potential of RBCs [24]

The Suggested Modification in Classification of RBCs

Color Adjustment Potential

Some examples of the paste-type RBCs available in the market are listed in Table 1, and the suggested classification according to the color adjustment potentials was presented.

Among all, composite kits including more than five shades in various levels of translucency were introduced many years ago. The color adjustment potential of these materials was better compared to the conventional previous versions. Moreover, because of the large number of shades (including enamel, dentin, and/or body shades), clinicians have to perform a precise shade selection protocol when using these kits to avoid the color mismatch problem. These composite kits generally include enamel shades and also include dentin and/or body shades. Regarding the restorative procedure, it can be considered that the body shades are the best options for monochromatic layering techniques due to the mid-level translucency. Thus, the absence of body shades in a composite kit forces the clinician to perform the restoration with a polychromatic layering technique. Accordingly, any kind of anterior and posterior polychromatic restorations and also the monochromatic restorations (if body shades are included), can be performed using the esthetic composite kits with polynumbered shades. The authors of this review suggest that the resin-based composite kits including more than five shades (enamel, dentin, and/or body shades) be named the **'polyshade' composites** (Table 1).

In recent years, with the increasing demands for simpler monochromatic layering techniques, manufacturers have developed some esthetic composite kits with better optical properties. These kits generally include enamel and /or dentin shades and more importantly a few (3 to 5 in number) body shades with enhanced color adjustment potential and with the ability to match all the 16 shades of Vita Classical Shade Guide. That means each body shade in these contemporary composite kits has the ability to mimic almost 3 to 5 different shades of the Vita Classical Shade Guide, giving clinicians the opportunity to perform the shade selection protocol in a simpler and safer way. In other words, these materials can 'work' for clinicians by reducing the color differences when the shade is mismatched [47••]. The suggestion is that the composite kits simplifying the shade selection procedure can be named the *'simplyshade' composites*. The decision of the 'simplyshade' feature should be determined through the following description of the manufacturer: 'having the ability to mimic all the shades in Vita Classical Shade Guide by only a few body shades.' Moreover, as an example, a composite kit may have the polyshade feature by including many shades in total and at the same time may also have the simplyshade feature by including a small group of body shades inside. There are some esthetic composite kits in the market which have both features and these materials are capable of performing any kind of monochromatic and polychromatic restorations in both anterior and posterior areas (Table 1).

Finally, a few manufacturers have developed esthetic RBCs in a single syringe that have the ability to mimic all the 16 shades of Vita Classical Shade Guide. These materials are so-called shade selection-free materials indicated for both anterior and posterior restorations, according to the manufacturers. Omnichroma (Tokuyama, Tokyo, Japan) is the first RBC with this feature indicated in both anterior and posterior restorations, with an innovative type of production by including no additive color pigments [47••]. Instead, Omnichroma has an enhanced nanostructure in terms of the inorganic filler type, distribution, and organization within the resin matrix, resulting in a highly improved level of color adjustment, named the 'structural color' phenomenon [50]. Structural color is a form of bioemulation, similar to the appearance of Morpho butterfly wings or peacock feathers [38••]. The multiple layers of photonic structures in these wings and feathers lead to a structural coloration with the visible light and thereby either destructive or constructive light interferences between the layers are generated. Each layer has both selective reflection and selective absorption of light at specific wavelengths therefore resulting in the perception of the brown pigmentation as brightly colored [51, 52]. Similarly, the structural color can be explained by the colors in a rainbow. The variously sized water drops in the air selectively reflect and absorb the light at specific wavelengths which results in the perception of different colors by the human eye [47••]. Accordingly, the manufacturer claims that Omnichroma can match any tooth color uniquely through the structural color feature. The uniformly 260-nm spherical and evenly spaced and arranged filler particles in Omnichroma composite are considered responsible for the transmittance of ambient light through the restoration, therefore reflecting the color of the surrounding dental tissues and generating red to yellow color [44, 53•, 54]. The increasing level of translucency parameter (TP) after the polymerization was also considered a contributing factor [48•, 53•]. Although there are no published clinical studies yet, Omnichroma has presented a high level of color matching *in vitro*, compared to the 'polyshade' composites [44, 45]. However, it is still open for interpretation, whether Omnichroma is successful in all kinds of restorations clinically. The answer to this question might be hidden in the recent act of the same manufacturer by providing an additional opaque shade (Omnichroma Blocker, Tokuyama), which

Table 1 Classification of RBCs according to the color adjustment potential

Color Adjustment Potential of Direct Composites			Manufacturer	Indication
Polyshade Composites	**Simplyshade Composites**	**Monoshade Universal Composites**		
Filtek Supreme Ultra Universal Restorative			3M	Anterior / Posterior
	Filtek Universal Restorative		3M	Anterior / Posterior
	Essentia	Essentia	GC Corp.	Anterior / Posterior
		Essentia Universal Kit	GC Corp.	Posterior
G-aenial			GC Corp.	Anterior / Posterior
G-aenial A'chord	G-aenial A'chord		GC Corp.	Anterior / Posterior
Clearfil Majesty Es-2 Classic			Kuraray Noritake	Anterior / Posterior
Clearfil Majesty Es-2 Premium			Kuraray Noritake	Anterior / Posterior
	Clearfil Majesty Es-2 Universal		Kuraray Noritake	Anterior / Posterior
Estelite Sigma Quick			Tokuyama	Anterior / Posterior
Palfique Estelite Paste			Tokuyama	Anterior / Posterior
Estelite Asteria	Estelite Asteria		Tokuyama	Anterior / Posterior
		Omnichroma	Tokuyama	Anterior / Posterior
Harmonize			Kerr Dental	Anterior / Posterior
	OptiShade		Kerr Dental	Anterior / Posterior
Mosaic			Ultradent Products	Anterior / Posterior
		Zenchroma	President Dental	Anterior / Posterior
Zenit			President Dental	Anterior / Posterior
Charisma Diamond			Kulzer	Anterior / Posterior
		Charisma Pearl One	Kulzer	Anterior / Posterior
		Charisma Diamond One	Kulzer	Anterior / Posterior
	NeoSpectra ST		Dentsply	Anterior / Posterior
	NeoSpectra ST Effects		Dentsply	Anterior / Posterior
		Vittra APS Unique	FGM	Anterior / Posterior
Vittra APS			FGM	Anterior / Posterior
		Admira Fusion x-tra	Voco	Anterior / Posterior
Amaris			Voco	Anterior / Posterior
	Brilliant EverGlow		Coltene	Anterior / Posterior
Tetric N-Ceram			Ivoclar Vivadent	Anterior / Posterior
IPS Empress Direct			Ivoclar Vivadent	Anterior / Posterior
Beautifil II			Shofu INC.	Anterior / Posterior
ENA HRi			Micerium	Anterior / Posterior
Enamel Plus HRi BioFunction			Micerium	Anterior / Posterior

is indicated for large or discolored cavities/lesions as an opaque base layer [53•, 54]. Some other brands have developed single syringe materials with similar color-adjusting potential claims like Omnichroma, whereas the production procedures are conventional, and additional pigments (for example ‘A2’ color) are included. More clinical data are needed to confirm these materials’ color adjustment potentials in posterior and anterior regions [48•, 53•, 54]. Nevertheless, these single syringe materials are all shade selection-free materials with the claim of the highest color adjustment potential by now, and therefore, a universal definition and an additional classification are required. The authors of this review suggest that the single syringe, shade selection-free composites can be named the *‘monoshade universal’ composites* (Table 1).

In addition, some recent flowable composite and bulk-fill composite kits include shades with enhanced color adjustment potentials. Even though these materials have the potential to get involved in the new suggested classification, the optical properties are not at the same level as the esthetic paste-type composites and there is a lack of clinical evidence in the literature regarding the long-term success of these materials. Therefore, only the paste-type composite kits were included in the suggested classification.

Conclusions

Depending on the highly esthetic demands of the patients, contemporary RBC kits with enhanced color adjustment potentials in various levels have been introduced in recent years. The color adjustment ability is considered very specific and particularly depends on the shade and brand of the selected composite kit. The current RBC classifications are generally inadequate in describing the shade-matching abilities of these new materials. It is the opinion of the authors of this review that an additional universal terminology and a related classification is required, describing the level of color adjusting the potential of the contemporary RBCs, in order to facilitate the material selection by practitioners in clinics. The suggested new classification divides RBCs into ‘polyshade,’ ‘simplyshade,’ and ‘monoshade universal’ composites. Although all the commercially available RBCs are not included, the authors think that this new modification in classification can serve as a simple guide to material selection in clinical applications as well as in scientific studies. Further modifications may be carried out with the developments regarding the color adjustment potentials of the newly developed restorative materials, including the ones in different viscosities.

Declarations

The Section Editors for the topical collection Dental Restorative Materials are Mutlu Özcan and Paulo Francisco Cesar. Please note that Section Editor Mutlu Özcan was not involved in the editorial process of this article as she is a co-author.

Conflict of Interest The authors declare no competing interests.

Human and Animal Rights and Informed Consent No animal or human subjects by the authors were used in this study.

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- • Of importance
- •• Of major importance

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