CLINICAL ORAL SCIENCE AND DENTISTRY

REVIEW ARTICLE ISSN 2688-7428 Open Access

Single-Shade Universal Resin Composites: Can Simplified Shade Selection Deliver Clinically Acceptable Esthetic Outcomes?

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Received date: October 01, 2026, **Accepted date:** October 07, 2026, **Published date:** October, 12 2026.

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Abstract

Single-shade resin composites have emerged as an alternative to conventional multi-shade restorative systems, with the goal of simplifying shade selection while maintaining acceptable esthetics. These materials are designed to achieve color integration through optical interaction with surrounding tooth structure, commonly referred to as the "chameleon effect" or color adjustment potential. This review summarizes current evidence regarding the optical behavior, color matching, restoration thickness, substrate effects, color stability, clinical applications, and limitations of single-shade composites. Recent evidence suggests that single-shade materials can provide clinically acceptable color integration in many routine restorations. However, laboratory studies frequently demonstrate greater color differences compared with multi-shade composites. Their optical performance is influenced by material composition, restoration thickness, cavity geometry, and underlying tooth shade. Current evidence remains predominantly laboratory based, with limited long-term clinical data. Single-shade composites should therefore be viewed as a useful simplification strategy rather than a universal replacement for multi-shade restorative systems.

Keywords

single-shade composite; universal composite; color adjustment; chameleon effect; CIEDE2000; translucency; esthetic dentistry; direct restoration

Introduction

Resin composites are widely used for direct restorations because they combine adhesive bonding, conservative preparation, adequate mechanical properties, and increasingly sophisticated esthetic characteristics. Achieving a natural appearance, however, depends not only on anatomy and surface finishing but also on the optical integration of the restoration with the surrounding tooth.

Conventional multi-shade composite systems provide different dentin, enamel, body, and translucent shades. This allows clinicians to reproduce variations in tooth color and optical properties but requires accurate shade selection, appropriate layering, and clinical experience.

Single-shade composites have been introduced to simplify this process. Rather than relying on multiple intrinsic shades, these materials are designed to interact optically with the surrounding tooth structure and produce a color that visually integrates with a range of substrates.

This phenomenon is commonly described as the "chameleon effect." More scientifically, it can be described as color adjustment or blending potential. Importantly, this effect is not identical for all materials and depends on factors including the restorative material, cavity dimensions, restoration thickness, and underlying substrate. [1]

Recent evidence illustrates the complexity of this issue. A 2025 systematic review and meta-analysis found that multi-shade composites generally demonstrated smaller instrumental color differences than single-shade materials in laboratory studies, although clinical studies reported promising outcomes for single-shade composites. [2] A 2026 scoping review identified 51 studies, including 41 laboratory and only 10 clinical studies, demonstrating that the evidence base remains predominantly in vitro. [3]

The purpose of this review is to examine whether single-shade composites can provide clinically acceptable esthetic outcomes and to identify the clinical circumstances in which their use may be appropriate.

Optical Basis of Single-Shade Composites

The perceived color of a restorative material results from the interaction of light with the composite and surrounding tooth. Reflection, absorption, scattering, transmission, translucency, and material composition all influence the final appearance.

Single-shade composites attempt to exploit these optical interactions. Rather than simply matching a predetermined tooth shade, the material allows the surrounding tooth structure to influence its perceived color.

This is the basis of the so-called chameleon effect. The composite itself does not literally change its intrinsic color. Instead, its optical properties allow the surrounding tooth to contribute to the appearance perceived by the observer.

Research has demonstrated that different resin composites possess different color adjustment potentials. Material type, cavity design, and surrounding substrate can significantly influence the result. [1,4]

Consequently, the term "single shade" should not be interpreted as meaning that all universal composites behave identically.

Role of Translucency and Restoration Thickness

Translucency is particularly important because it determines how much the underlying substrate contributes to the appearance of the restoration.

A highly opaque material masks the underlying structure, whereas a translucent material permits greater interaction between the restoration and substrate. Therefore, the same composite may demonstrate different color behavior depending on its thickness.

Studies evaluating one-shade composites have shown significant differences in translucency among products, with optical properties also changing as material thickness increases. [5]

A 2026 investigation evaluating different single-shade composites at thicknesses of 0.5, 1, and 2 mm demonstrated that both restoration thickness and underlying substrate affected color outcomes. [6]

These findings have direct clinical implications. A material that blends effectively in a shallow Class III or Class V restoration may behave differently when used in a deeper restoration requiring greater replacement of tooth structure.

Therefore, clinicians should consider both the material's optical characteristics and the thickness recommended by the manufacturer.

Influence of the Underlying Tooth Shade

The substrate beneath a restoration can strongly influence its final appearance. This is especially relevant in teeth with:

- dark or discolored dentin;
- deep carious lesions;
- endodontic discoloration;
- previous restorative materials;
- or severely altered tooth structure.

The blending capability of a single-shade composite is therefore not unlimited. A highly translucent material may allow a dark substrate to influence the final color substantially.

Recent research demonstrated that both material type and substrate shade affect the color matching of single-shade composites. [6,7]

This suggests that the term “universal shade” should be interpreted as a broad shade range rather than as a guarantee of successful color matching under every clinical condition.

Single-Shade Versus Multi-Shade Composites

The most important clinical question is whether simplified shade selection compromises esthetic accuracy.

A 2025 systematic review and meta-analysis included 15 in-vitro studies and four randomized clinical trials. In laboratory studies, single-shade composites generally demonstrated greater color differences than multi-shade materials when evaluated instrumentally. However, the clinical trials reported promising outcomes for single-shade composites. [2]

This difference may partly result from the distinction between instrumental and visual evaluation.

Color-measuring instruments can detect relatively small differences in lightness, chroma, and hue. Clinically, however, restorations are viewed within a complex three-dimensional environment involving tooth morphology, surface texture, illumination, saliva, adjacent teeth, and viewing conditions.

The 2026 scoping review similarly identified differences between laboratory and clinical findings. Instrumental measurements tended to favor multi-shade composites, while clinical assessments generally found acceptable performance with single-shade materials. [3]

Therefore, laboratory evidence should not be interpreted as proof that single-shade restorations are clinically unacceptable. Conversely, satisfactory short-term clinical appearance does not establish that single-shade composites can replace multi-shade systems in all situations.

Clinical Applications

Single-shade composites may be particularly useful in routine restorations where extreme optical customization is unnecessary.

Potential applications include:

- small posterior Class I and Class II restorations;
- small anterior Class III restorations;
- selected Class V or cervical restorations;
- routine restorative procedures where simplified shade selection is beneficial;
- situations where chairside efficiency is important.

Their use may reduce the number of shades that must be selected and maintained in clinical inventory.

However, simplified shade selection does not eliminate the need for clinical judgment. The clinician should still evaluate tooth color, restoration size, substrate shade, restoration thickness, translucency requirements, and patient expectations.

When Multi-Shade Composites May Be Preferable

Single-shade materials should not be considered replacements for conventional multi-shade systems in every situation.

Multi-shade layering may remain preferable when:

- a large amount of anterior tooth structure must be replaced;
- highly individualized esthetics are required;
- significant tooth discoloration is present;
- distinct dentin and enamel optical effects must be reproduced;
- complex incisal translucency or characterization is required;
- or maximum control over value, chroma, opacity, and translucency is desired.

The primary distinction is therefore between simplification and customization.

Single-shade materials are designed primarily to simplify the restorative process, whereas multi-shade systems offer greater control over complex optical characteristics.

Color Stability

Initial color matching does not necessarily predict long-term esthetic stability. A recent systematic review of 11 in-vitro studies evaluating single-shade composites found that discoloration increased over time following exposure

to staining conditions. Substances such as turmeric and red wine produced substantial staining in several experimental models. The review also reported that single-shade materials were generally more susceptible to discoloration than multi-shade materials, although considerable variation existed among individual products. [8]

These findings should be interpreted cautiously because laboratory staining conditions do not completely reproduce the oral environment.

Factors such as saliva, toothbrushing, dietary frequency, surface roughness, polishing, and oral hygiene may influence clinical staining.

Nevertheless, color stability represents an important area for future clinical investigation.

Clinical Efficiency

One of the major potential advantages of single-shade composites is procedural simplification.

Traditional shade selection may require assessment of enamel and dentin shades, evaluation of translucency, consideration of tooth dehydration, and sometimes trial placement.

Single-shade systems can reduce this complexity and may decrease the number of composite shades required for routine restorative procedures.

However, the term “single-shade” should not be interpreted as “no shade assessment.” Clinicians should still evaluate the substrate, restoration size, material thickness, and esthetic demands before selecting the material.

The material simplifies shade selection but does not replace clinical judgment.

Limitations of Current Evidence

Despite increasing interest in single-shade composites, several limitations remain.

First, most available evidence is laboratory based. The 2026 scoping review identified 51 studies, but only 10 were clinical studies. [3]

Second, many studies have relatively short observation periods, limiting conclusions regarding long-term clinical performance.

Third, studies use different substrate shades, specimen thicknesses, cavity designs, color-measurement systems, and evaluation methods, making direct comparisons difficult.

Finally, evidence is concentrated around a limited number of commercially available products. The 2026 scoping review reported that Palfique Omnichroma appeared in 46 of the 51 included studies. [3]

Therefore, findings from one extensively studied product should not automatically be generalized to every single-shade composite.

Future Research

Future investigations should focus on clinically relevant questions rather than simply determining whether single-shade materials are superior to multi-shade systems.

Important areas include:

1. Effect of thickness: evaluating multiple clinically relevant restoration thicknesses.

2. Substrate effects: investigating normal, darkened, and discolored tooth structures.

3. Clinical perception: correlating instrumental CIEDE2000 measurements with clinician and patient assessments.

4. Long-term color stability: determining whether laboratory staining susceptibility translates into clinically meaningful discoloration.

5. Material-specific behavior: comparing different single-shade technologies rather than treating all universal composites as equivalent.

6. Mechanical performance: evaluating fracture resistance, wear, polymerization behavior, and marginal integrity alongside esthetics.

Long-term randomized clinical trials using standardized assessment methods would provide stronger evidence for clinical decision-making.

Conclusion

Single-shade resin composites represent an important development in esthetic restorative dentistry. Their primary advantage is the ability to simplify shade selection while using optical interaction with the surrounding tooth to achieve clinically acceptable color integration.

Current evidence demonstrates that color adjustment is influenced by material composition, restoration thickness, substrate shade, and cavity geometry. Laboratory studies generally demonstrate more precise instrumental color matching with multi-shade systems, whereas emerging clinical evidence suggests that single-shade composites can achieve satisfactory visual outcomes in appropriately selected cases.

Therefore, single-shade composites should currently be regarded as a simplification strategy rather than a universal replacement for multi-shade restorative systems.

Their greatest clinical value may be in routine direct restorations where procedural efficiency and acceptable esthetics are desired. Highly complex anterior restorations, severely discolored teeth, and cases requiring individualized optical characterization may still benefit from multi-shade techniques.

Further long-term clinical research is necessary to determine whether the promising short-term clinical results translate into durable esthetic performance.

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