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The Art of Aesthetics: Gingiva-Colored Composites in Restorative Dentistry: A Narrative Review

Estetiğin Sanatı: Restoratif Diş Hekimliğinde Diş Eti Rengi Kompozitler: Anlatısal Bir Derleme

Şeyda SAÇAN[1], Mehmet SALIK[2]

[1] Dicle University Faculty of Dentistry, Department of Restorative Dentistry, Diyarbakir, Türkiye

ORCID ID: 0000-0002-1571-8467

[2] Dicle University Faculty of Dentistry, Department of Restorative Dentistry, Diyarbakir, Türkiye,

ORCID ID: 0009-0001-4142-688X

Corresponding Author:

Şeyda SAÇAN

Diyarbakır Üniversitesi, Diş Hekimliği Fakültesi, Restoratif Diş Tedavisi Anabilim Dalı, Samsun, Türkiye

e-mail: *seyda_seyda@windowslive.com*

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Abstract

Esthetic rehabilitation in restorative dentistry requires harmonious integration of both tooth and gingival tissues. Gingival recessions, black triangles, and peri-implant soft tissue deficiencies frequently compromise smile esthetics and patient satisfaction. Gingiva-colored composites have been introduced as minimally invasive restorative options to manage these conditions.

This narrative integrative review evaluates the clinical relevance of gingiva-colored composites, focusing on their material properties, indications, application techniques, esthetic outcomes, and future developments.

A narrative literature review was conducted using PubMed, Scopus, and Google Scholar databases. Peer-reviewed English-language publications from 2000 to 2024 addressing gingiva-colored composites, pink esthetics, black triangle restoration, and peri-implant soft tissue rehabilitation were included and qualitatively analyzed.

The literature demonstrates that gingiva-colored composites provide effective esthetic rehabilitation for gingival recessions, papilla deficiencies, and peri-implant soft tissue defects. Improvements in composite formulation, adhesive systems, and finishing protocols have enhanced color stability, marginal adaptation, and biocompatibility. High levels of patient satisfaction and favorable esthetic outcomes are consistently reported, particularly when appropriate shade selection, isolation, and layering techniques are applied.

Gingiva-colored composites represent a conservative and clinically effective approach for pink esthetic management in restorative dentistry. With proper case selection and application protocols, predictable esthetic outcomes can be achieved. Future integration of digital technologies, bioactive materials, and artificial intelligence–assisted shade matching is expected to further optimize clinical performance, although long-term clinical data remain limited.

Keywords: *Gingiva-colored composites, pink esthetics, black triangle restoration, soft tissue esthetics, nanohybrid composites.*

Özet

Restoratif diş hekimliğinde estetik rehabilitasyon, hem diş hem de diş eti dokularının uyumlu entegrasyonunu gerektirir. Diş eti çekilmeleri, siyah üçgenler ve peri-implant yumuşak doku yetersizlikleri sıklıkla gülümseme estetiğini ve hasta memnuniyetini olumsuz etkiler. Diş eti renginde

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kompozit malzemeler, bu durumları yönetmek için minimal invaziv restoratif seçenekler olarak tanıtılmıştır.

Bu anlatısal bütünleştirici inceleme, diş eti renginde kompozit malzemelerin klinik önemini, malzeme özelliklerine, endikasyonlarına, uygulama tekniklerine, estetik sonuçlarına ve gelecekteki gelişmelerine odaklanarak değerlendirmektedir.

PubMed, Scopus ve Google Scholar veritabanları kullanılarak anlatısal bir literatür taraması yapılmıştır. 2000-2024 yılları arasında diş eti renginde kompozitler, pembe estetik, siyah üçgen restorasyonu ve peri-implant yumuşak doku rehabilitasyonu konularını ele alan hakemli İngilizce yayınlar dahil edilmiş ve niteliksel olarak analiz edilmiştir.

Literatür, diş eti rengindeki kompozitlerin diş eti çekilmeleri, papilla yetersizlikleri ve peri-implant yumuşak doku defektleri için etkili estetik rehabilitasyon sağladığını göstermektedir. Kompozit formülasyonu, yapıştırıcı sistemler ve bitirme protokollerindeki gelişmeler, renk stabilitesini, marjinal uyumu ve biyouyumluluğu artırmıştır. Özellikle uygun renk seçimi, izolasyon ve katmanlama teknikleri uygulandığında, yüksek düzeyde hasta memnuniyeti ve olumlu estetik sonuçlar sürekli olarak bildirilmektedir.

Diş eti rengindeki kompozitler, restoratif diş hekimliğinde pembe estetik yönetimi için konservatif ve klinik olarak etkili bir yaklaşımı temsil etmektedir. Uygun vaka seçimi ve uygulama protokolleriyle, öngörülebilir estetik sonuçlar elde edilebilir. Dijital teknolojilerin, biyoaktif malzemelerin ve yapay zeka destekli renk eşleştirmenin gelecekteki entegrasyonunun, klinik performansı daha da optimize etmesi beklenmektedir, ancak uzun vadeli klinik veriler sınırlıdır.

Anahtar Kelimeler: *Diş eti renginde kompozitler, pembe estetik, siyah üçgen restorasyon, yumuşak doku estetiği, nanohibrid kompozitler.*

OVERVIEW / GENEL BAKIŞ

In modern dentistry, where esthetic expectations are steadily increasing, not only the restoration of teeth but also the natural appearance of the surrounding soft tissues has become an important goal. Gingiva-colored composites, developed in this context, provide the opportunity to address problems such as gingival recession, papilla loss, and the formation of black triangles through minimally invasive methods (1). The ability of these materials to offer an esthetic, biocompatible, and clinically durable solution that mimics the appearance of gingival tissues has brought them to the forefront as an alternative to conventional surgical approaches.

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The use of gingiva-colored composites emerged in the early 2000s, primarily to meet esthetic demands in implant-supported restorations. Over time, it became evident that these materials could also be applied to address esthetic concerns caused by periodontal problems, post-traumatic papilla loss, or procedures such as crown lengthening (2). Consequently, gingiva-colored composites have evolved into a comprehensive restorative option both functionally and esthetically.

Gingival esthetics is defined not only by the presence of pink tissues but also by their symmetrical, healthy, and natural appearance. In anterior restorations in particular, gingival contour and color are crucial elements of the overall esthetic perception. Conventional resin composites often fall short in these areas, as mismatches in shade and texture between the restoration and the gingiva lead to unsatisfactory results. At this point, gingiva-colored composites gain significance. These materials are offered in different shades (such as light, medium, and dark), allowing for restorations that closely match an individual's natural gingival color (2).

Gingiva-colored composites can be applied either directly or indirectly. Direct applications are performed chairside, allowing for faster results, while indirect applications are prepared in the laboratory, often ensuring higher esthetic and functional success. Regardless of the technique chosen, the color, opacity, gloss, and natural transition of the material with surrounding tissues directly influence the success of the treatment.

In addition to their advantages, gingiva-colored composites also present certain limitations. They may show changes in color stability over time, necessitating regular maintenance and polishing procedures. Furthermore, biological boundaries must be respected at the interface with gingival tissues; otherwise, improper applications may lead to gingival irritation and esthetic failure (3).

In recent years, restorative practices supported by CAD/CAM systems, digital shade-matching tools, and 3D printing have further expanded the applications of gingiva-colored composites. The ability to provide patient-specific planning in esthetic restorations has increased the significance of these materials (3). Additionally, for individuals unsuitable for surgical intervention or unwilling to undergo invasive procedures, gingiva-colored composites present a conservative and patient-friendly alternative.

This review aims to comprehensively examine the role of gingiva-colored composites in restorative dentistry, their historical development, physical and chemical properties, application techniques, clinical performance, and future perspectives. The objective is to provide a broad perspective on their use and to support clinicians' treatment decisions with evidence-based information. This article is designed as a narrative integrative review synthesizing existing evidence on gingiva-colored composite (4).

Methods

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This review was designed as a narrative integrative review aimed at synthesizing current knowledge on gingiva-colored composite used in restorative dentistry. A comprehensive literature search was conducted using electronic databases including PubMed, Scopus, and Google Scholar. The search strategy combined keywords such as *"gingiva-colored composite," "pink composite," "gingival esthetics," "black triangle restoration," "peri-implant soft tissue esthetics,"* and *"pink esthetic score (PES)."*

Peer-reviewed articles published in English from 2000 to 2024 were considered. Original research articles, clinical studies, in vitro investigations, case series, and review papers addressing material composition, physical and mechanical properties, adhesive behavior, clinical indications, esthetic outcomes, and patient satisfaction were included. Studies focusing solely on surgical periodontal procedures or unrelated prosthetic materials were excluded.

Relevant references were screened based on titles and abstracts, followed by full-text evaluation for eligibility. Additional articles were identified through manual screening of reference lists from selected publications. The findings were synthesized qualitatively and organized into thematic sections covering historical development, material science, clinical applications, esthetic performance, and future perspectives of gingiva-colored composite**.**

Historical Development of Gingiva-Colored Composites

The historical development of materials used in restorative dentistry is directly related to the evolution of esthetic and functional expectations. While materials designed for the restoration of dental hard tissues advanced rapidly from the mid-20th century onward, soft tissue esthetics had long been neglected. However, a natural smile achieves harmony not only through white esthetics (teeth) but also through pink esthetics (gingiva). Consequently, the need for materials capable of providing color harmony in the gingival region emerged, laying the foundation for the development of gingiva-colored composites (3).

In the late 1990s and early 2000s, some clinicians attempted to modify existing composite materials to create restorations compatible with the appearance of gingival tissues. This period can be regarded as the first attempts at applying esthetic restorative materials to the gingival region. Nevertheless, these efforts achieved only limited success due to restrictions in shade availability, opacity problems related to material thickness, and insufficient long-term color stability (1).

In response to this need, manufacturers of esthetic restorative materials introduced the first gingiva-colored composites to the market. European companies, in particular, were pioneers in this field. The first-generation gingiva-colored composites included only a limited number of shades, generally confined to pink tones. The opacity and translucency characteristics of these materials were insufficient to reproduce the natural gingival tissues faithfully (2).

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Products such as GC Gradia Gum (GC Europe) and Amaris Gingiva (VOCO, Germany) are considered milestones in the development of these materials. The GC Gradia system offered shade options representing various gingival tones, including *dark reddish*, *light pink*, *standard*, and *brownish*, in addition to providing opaque and effect shades designed to assist in shaping gingival architecture. These advances paved the way for pink esthetic applications in both fixed prostheses and implant-supported restorations. Historically, gingiva-colored restorative options have not been limited to composites. With the development of CAD/CAM systems, gingiva-colored acrylic blocks and ceramic restorations also became available. These blocks enabled more natural simulation of gingival tissues in indirect prostheses, improving color stability and enhancing biocompatibility (4).

Over the past decade, the emphasis has shifted not only toward visual similarity but also toward the periodontal tissue–friendly characteristics of these materials. Nanohybrid structures, surface coatings enhanced with color pigments, and the ability to achieve a highly polished finish have made gingiva-colored increasingly popular in clinical practice. Their use is particularly favored in patients with a history of periodontal disease, as they eliminate the need for surgical intervention and provide a conservative treatment alternative (4).

Today, gingiva-colored composites are not only employed in anterior restorations but are also widely applied in complete dentures, peri-implant restorations, and even posterior areas. This widespread utilization is attributable not only to improvements in material properties but also to increased awareness among dental practitioners.

In this context, the historical development of gingiva-colored composites represents a significant example of the evolution of restorative material technologies and the growing importance placed on patient esthetics. In modern clinical practice, the use of these materials has become not merely an alternative but, in many cases, the preferred first-line approach.

Physical, Chemical, Mechanical, and Adhesive Properties of Gingiva-Colored Composites

Gingiva-colored composite have been specifically developed to reproduce the natural appearance of soft tissues in esthetic restorations. Their success as restorative solutions depends not only on color harmony but also on their physical, chemical, mechanical, and adhesive properties. This section provides a detailed overview of these fundamental characteristics.

The physical properties of gingiva-colored composites are critical for both esthetic quality and long-term clinical success. The most important physical properties include shade range, opacity, translucency, polishability, and surface roughness (2).

- Shade Range: The success of pink esthetics is directly related to the proper selection of gingival shade. Today, these materials are available in numerous tones such as *light pink, standard*

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pink, dark pink, and *brownish*, which provide better adaptation to individual gingival pigmentation (1).

- Opacity and Translucency: Gingival tissue is naturally more opaque than tooth structure. Therefore, gingiva-colored composites are expected to have higher opacity. However, for a natural appearance, a stratification technique allowing slight translucency at the surface is recommended (1).

- Surface Roughness and Polishability: The polishability of the material is crucial for reducing plaque accumulation and maintaining esthetic appearance. Gingiva-colored composites can achieve a glossy finish after polishing; however, this property is closely related to the particle size used (1).

Structurally, these materials are similar to conventional resin composites but contain special pigments and fillers that mimic the esthetics of pink tissues:

- Resin Matrix: Commonly composed of monomers such as Bis-GMA, UDMA, and TEGDMA, which provide flow, polymerization capability, and mechanical strength (4).

- Fillers: Inorganic particles such as glass ceramics, silica, and zirconia increase mechanical strength and contribute to color stability. Nanohybrid and microfilled structures offer improved polishability (4).

- Pigments**:** Various pigments, including iron oxides, cobalt, and organic dyes, are incorporated to achieve gingival tones. These pigments are stabilized to resist UV light (4).

The mechanical properties of gingiva-colored composites determine their resistance to masticatory forces and external influences. These properties vary depending on filler content and polymerization systems:

- Compressive and Flexural Strength: Compared to conventional tooth-colored composites, gingiva-colored composites generally exhibit lower compressive strength (average 120–180 MPa). However, since gingival restorations are not directly subjected to masticatory forces, these values are considered adequate (6).

- Wear Resistance: Although mechanical stress in gingival restorations is low, resistance to micro-abrasion from brushing and mastication is important. Nanohybrid structures provide superior wear resistance (6).

- Elastic Modulus: This value reflects the material's ability to flex. Greater flexibility is preferred in gingival areas due to contact with mobile mucosa (6).

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In addition to material properties, the adhesive bond to the substrate surface is essential for clinical success. Gingiva-colored composites are typically applied to the cervical regions of teeth, which consist of dentin or cementum surfaces.

- Bonding Surfaces**:** Since gingiva-colored composites are often applied at the dentin–cementum junction, compatibility with hydrophilic adhesive systems is important. Self-etch systems have been reported to yield more stable results in these areas (7).

- Marginal Adaptation: Marginal adaptation is critical in the gingival region. Poor adaptation may lead to gingival irritation. Therefore, bonding agents with high flow are recommended (7).

- Polymerization Shrinkage: Some gingiva-colored composites demonstrate greater polymerization shrinkage compared to conventional materials. This can generate stress at restoration margins and cause microleakage. For this reason, low-shrinkage materials should be selected, or the incremental layering technique should be applied (7).

Clinical Indications and Applications

Gingiva-colored composites have been developed in line with the increasing esthetic demands in restorative dentistry, serving as innovative materials designed to ensure color and morphological harmony of gingival tissues. In clinical practice, these materials are applied in a variety of indications depending on different periodontal problems and restorative needs. This section discusses in detail the most common indications and clinical applications of gingiva-colored composites (8).

Gingival recession is a common problem resulting from periodontal disease, trauma, improper toothbrushing techniques, or orthodontic treatment. Recession exposes the root surfaces, causing both functional and esthetic concerns. In addition, interproximal gingival loss, commonly referred to as *black triangles*, negatively affects smile esthetics, especially in the anterior region (9). Gingiva-colored composites are ideal for closing such gingival defects in a minimally invasive manner without surgical intervention. By directly filling the interproximal spaces, these materials effectively reduce the appearance of black triangles, leading to both functional and esthetic improvements and increased patient satisfaction (8).

Implant therapy is widely used for tooth replacement, and the esthetics of peri-implant soft tissues represent a critical success factor. Mismatched gingival color around implant-supported prostheses can significantly compromise smile esthetics (10). Gingiva-colored composites are frequently used to enhance the pink esthetics of implant-supported restorations. By applying the composite to areas of the prosthesis adjacent to the gingival margin, the natural appearance of soft tissues can be simulated. This provides a conservative solution, particularly in cases of soft tissue deficiencies following surgery (2).

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In **fixed prostheses**, especially in the anterior region, the harmony between the gingiva and the prosthetic crown or bridge is a key determinant of esthetic success. Gingiva-colored composites are used in the marginal areas of these restorations to achieve color and tissue compatibility, thereby enhancing natural appearance and patient satisfaction (4).

Exposed root surfaces due to gingival recession represent both a risk for dentin hypersensitivity and caries development. Application of gingiva-colored composites on root surfaces provides a protective covering layer, improving esthetics while reducing dentin sensitivity. Clinical observations have reported reductions in patients' complaints of sensitivity following treatment (9).

Trauma-related defects of gingival tissues can also be restored using gingiva-colored composites through non-surgical methods, offering patients a more comfortable and less invasive treatment alternative (1).

Pigmentation disorders or various dermatologic conditions may cause gingival discolorations, which can create esthetic concerns. Gingiva-colored composites can mask such discolorations and provide esthetic restorations by mimicking natural pink tones (2).

Following **periodontal surgery**, gingiva-colored composites are commonly used to esthetically camouflage soft tissue loss during the healing phase. This not only relieves the patient's esthetic concerns but also allows for better management of the surgical recovery process (11).

In **edentulous patients**, gingival appearance plays a critical role in denture esthetics. Gingiva-colored composites can be applied to denture bases to simulate the natural color and texture of gingival tissues, thereby providing patients with a more natural smile (4).

Clinical Application Techniques

The clinical success of gingiva-colored composite depends not only on material selection but also on the application technique. The potential of these materials to mimic gingival esthetics can only be fully realized when combined with the correct clinical protocol (5). This section provides a detailed explanation of all the steps involved in the application of gingiva-colored composites.

The first step in treatment planning is to assess the patient's esthetic expectations. Indications such as gingival recession, papilla loss, presence of black triangles, and implant-supported restorations should be identified. Shade selection is performed by considering gingival color, surrounding tissue characteristics, and lighting conditions. Shade matching should always be conducted under natural light using a gingiva composite shade guide (2).

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For a successful restoration, proper isolation is essential. In the gingival region, contamination by blood and saliva negatively affects bonding success. Therefore, the use of cotton rolls, retraction cords, gingival elevators, and, when necessary, a rubber dam is recommended.

- On enamel/dentin surfaces: Following surface roughening, selective etching or self-etch primer can be applied for surface preparation (6).
- On root surfaces**:** Self-etch systems are preferred for removing the smear layer and opening dentinal tubules. After applying the adhesive system, light-curing is performed according to the manufacturer's instructions (6).

Gingiva-colored composites are generally applied using the direct technique. However, in cases with high esthetic demands, the layering technique can achieve the most natural outcome (9):

- Opaque layer (inner layer): Establishes gingival contour and volume.
- Translucent layer (surface): Provides natural color blending and softens shade transitions.
- Effect pigments: When necessary, special pigments (white, brown, red) may be used to simulate vascularization or localized color variations.

All layers should be applied and polymerized according to the manufacturer's instructions. Gingiva-colored composites can be placed either directly or indirectly:

1. Direct Application:
    - Performed chairside in the clinical setting.
    - Commonly used for black triangle restorations, papilla simulation, and root surface coverage.
    - Short treatment duration; usually completed in a single session (10).
2. Indirect Application:
    - Applied to gingival areas of laboratory-fabricated restorations.
    - Frequently preferred in implant-supported fixed prostheses and hybrid prostheses.
    - CAD/CAM-supported techniques enhance color stability and tissue adaptation (10).

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To achieve a natural gingival appearance, surface texturing is crucial. The natural "orange peel" texture of gingiva can be reproduced using spatulas, brushes, and silicone shapers. For finishing and polishing:

- Fine diamond burs are used for contouring.
- Polishing discs (e.g., Sof-Lex™), polishing rubbers, and polishing pastes are applied to achieve surface gloss.
- A smooth and glossy surface reduces plaque accumulation and improves biological compatibility (8).

Common mistakes and pitfalls in these applications include:

- Incorrect shade selection: A gingiva-specific shade guide must be used.
- Excessive bulk application: Leads to incomplete polymerization.
- Inadequate isolation: Results in bonding failure and microleakage.
- Sharp margin formation**:** Smooth transitions with soft tissues must be ensured (10).

After gingiva-colored restorations are completed, patients should receive personalized hygiene instructions. In particular, the use of abrasive toothpastes should be avoided, gentle brushing should be recommended, and polishing should be repeated every six months (6).

Esthetic Success and Patient Satisfaction

In restorative dentistry, the evaluation of esthetic success is determined not only by clinical parameters but also by patient satisfaction. The use of gingiva-colored composites aims to achieve "pink esthetics," which extends beyond functional restoration to include emotional and social impact. This section evaluates the esthetic success of gingiva-colored composites using both objective and subjective criteria and explores their influence on patient satisfaction (11).

In gingival restorations, esthetic success depends on several factors such as shade harmony, tissue resemblance, surface gloss, invisibility of restoration margins, and overall harmony. A successful restoration should:

- Ensure color continuity with adjacent gingival tissues,
- Present an indistinguishable tooth–tissue transition,
- Display natural brightness and tissue imitation,

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- Improve overall smile esthetics (11).

These criteria also apply to conventional composite restorations; however, in gingival areas, particular attention must be given to tissue resemblance and the balance between opacity and natural translucency (2). Esthetic success, especially in anterior implant-supported restorations, is often measured using the Pink Esthetic Score (PES) and White Esthetic Score (WES) systems (13). PES incorporates gingival esthetic parameters, including:

- Presence of papillae,
- Gingival contour,
- Tissue level,
- Shade harmony,
- Tissue texture and brightness (12).

Studies have shown significant increases in PES values following gingiva-colored composite applications, demonstrating that these restorations are successful not only esthetically but also in clinical evaluation (13).

Esthetic concerns directly influence social interactions, self-confidence, and quality of life. Black triangles, exposed root surfaces, or peri-implant tissue deficiencies may cause psychosocial stress, particularly in young and socially active individuals. Rehabilitation of such areas with gingiva-colored composites creates a more natural smile, reduces esthetic concerns, increases self-confidence, and improves patient satisfaction by providing results without the need for surgery. In a study by Raj et al. (4), 91% of patients who received gingiva-colored composite restorations rated the treatment outcome as "esthetically satisfactory."

Long-term follow-up raises the question of whether gingiva-colored composites maintain their esthetic appearance. The polymeric structure's sensitivity to environmental factors may cause problems such as discoloration over time. However, current nanohybrid technology has significantly improved resistance to such issues (13). Mehl et al. (2) conducted a comprehensive literature review on the development, material properties, clinical indications, and application techniques of gingiva-colored composites, comparing direct and indirect techniques, and emphasized the advantage of nanohybrid structures in terms of polishability. In their study, 85% of cases followed for two years or more maintained color stability and patient satisfaction. Furthermore, restorations with good polish and regular maintenance demonstrated low plaque accumulation and minimal marginal irritation (15,16).

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One frequently encountered issue in esthetic evaluations is the difference in success criteria between clinicians and patients. While a clinician may regard a restoration as technically successful and esthetically adequate, patients may perceive shade differences in gingival tones or minimal surface irregularities. For this reason, preoperative photographs, digital mock-ups, and shade guides should be used for patient communication. Effective dentist–patient communication is directly linked to treatment success, particularly in anterior implant-supported restorations and esthetic rehabilitations (14). Clinician-related factors that help maintain esthetic success long-term include:

- Shade-matching ability: Accurate analysis of natural gingival tone is essential.
- Layering technique: A balanced use of opaque and translucent materials is necessary.
- Polishing and contouring skills: A smooth, natural tissue-like surface must be achieved.
- Knowledge of gingival anatomy: Attention should be paid to the patient's individual gingival contour characteristics (16).

Over the last two decades, gingiva-colored composites have gained significant importance in esthetic restorative approaches. A review of the scientific literature reveals numerous in vitro and clinical studies evaluating their esthetic success, biocompatibility, long-term performance, and contribution to patient satisfaction. The collective findings from these studies demonstrate that:

- Gingiva-colored composites play an important role in esthetic rehabilitation.
- Their most common indications are restoration of black triangles, peri-implant tissue simulation, and coverage of gingival recessions.
- Patient satisfaction is generally high, particularly due to the avoidance of surgical interventions.
- New-generation nanohybrid materials demonstrate superior color stability and biocompatibility.
- High PES/WES scores are consistently achieved with these materials (14).

Future Perspectives and Clinical Recommendations

Gingiva-colored composites represent one of the most delicate refinements of esthetic approaches in restorative dentistry. Their importance continues to grow in response to increasing patient expectations, technological advancements, and multidisciplinary treatment approaches.

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Current formulations of gingiva-colored composites provide high opacity, natural shade options, and good polishability. However, future innovations are anticipated with ongoing scientific developments:

- Color-adaptive technologies: "Smart pigment" technologies are being developed to automatically match the color of surrounding gingival tissue, enabling multiple tissue shades to be reproduced using a single material (16).
- Self-healing composites: Nano-mechanical systems capable of detecting and repairing microscopic cracks are expected to be integrated into gingiva-colored composites, particularly for use in esthetic zones (16).
- Bioactive properties: New formulations with fluoride release, pH buffering capacity, or biochemical interaction with soft tissues are being explored. Such bioactive gingiva-colored composites may not only provide esthetics but also promote periodontal healing (17).
- Antibacterial surfaces: To minimize plaque retention in gingival areas, technologies incorporating silver nanoparticles or chlorhexidine delivery systems are under investigation (8).

Integration of gingiva-colored composites with digital technologies will make clinical workflows more predictable and efficient. With CAD/CAM systems, digital scanners and software can analyze gingival morphology in detail, allowing individualized design of gingiva-colored restorations (17). Some manufacturers have already introduced digitally manufactured gingiva blocks. Additionally, 3D printing technology enables the production of customized gingival prosthetic components, soft tissue simulations, and pink esthetic support materials using photopolymerization. This method offers notable advantages in complete dentures and implant-supported hybrid restorations (18). Furthermore, digital shade analysis systems, including spectrophotometric and artificial intelligence-based tools, allow for objective determination of gingival color, facilitating optimal shade selection (19).

Despite these advancements, gingiva-colored composites are still only marginally included in dental curricula across many countries. Yet, pink esthetics has become an inseparable part of smile design. Digital simulation software should be introduced in dental education, offering students the opportunity to practice various gingival defects and treatment modalities virtually. Clinical internship programs, particularly in implantology and esthetic dentistry rotations, should incorporate training on gingival restorations. Contemporary studies confirm that when applied with appropriate education and skill, the clinical success of these materials is high (4).

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Several key considerations are important in clinical use. Better outcomes are observed in patients with high esthetic demands, those unwilling to undergo surgical procedures, and those with good oral hygiene. As the gingival region is prone to contamination, ideal isolation must be ensured. Layering techniques using opaque and translucent resins determine the natural appearance of the restoration. Shade stability, plaque accumulation, and marginal adaptation should be regularly monitored, with polishing procedures repeated at regular intervals (20).

Patient expectations regarding esthetics are becoming increasingly detailed. A growing number of individuals undergoing smile design now evaluate not only tooth color but also gingival form. Therefore, clinicians should actively present gingiva-colored restorations as an option, providing patient education through pre-/post- treatment photographs and digital mock-ups. Additionally, responsible information-sharing through social media can increase public awareness of these treatment options (21).

SUMMARY / SONUÇ

This field is still relatively new and has certain limitations. There is a need for long-term clinical studies (≥5 years). The influence of diet and oral hygiene habits on color stability must be clarified. Comparative studies among different composite systems (nanohybrid, microfilled, ormocer-based) should be conducted. Furthermore, the psychological effects on patients require more comprehensive evaluation, taking cultural differences into account.

Gingiva-colored composites have emerged as innovative materials in modern restorative dentistry, offering a combination of esthetics, biocompatibility, and functional integrity. They represent an effective conservative alternative for the rehabilitation of gingival recessions, black triangles, and soft tissue deficiencies. Advances in composite material technology have significantly enhanced their performance in terms of color stability, opacity adaptation, and mechanical resistance. In addition, the use of digital shade-matching systems, CAD/CAM-assisted manufacturing techniques, and biomimetic approaches has further improved the sustainability of clinical success.

Nevertheless, there remains a need for prospective studies focusing on long-term clinical outcomes and patient satisfaction. In conclusion, gingiva-colored composites are not only an esthetic solution but also a restorative approach that aligns with the philosophy of minimally invasive dentistry while supporting both functional and biological integrity.

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