

Contemporary Trends in Esthetic Prosthodontics: Materials and Minimally Invasive Approaches

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Abstract

Esthetic prosthodontics has changed a lot during the last twenty years. New biomaterials, improved adhesive methods and new digital workflows have led to these changes. The old belief that massive reduction of tooth is required for mechanical retention is not the norm anymore. Modern treatments are based on minimal invasion and biological principles. Clinicians now strive to save as many natural teeth as possible, to achieve better harmony with soft tissues, and to use high-performance ceramics and hybrids, which not only give better looks but also better durability. Digital dentistry has had a huge impact, too. CAD/CAM systems, intra-oral scanners, digital smile design and AI tools support precision, speed and patient experience. This review examines the current state of art with regard to esthetic materials, conservative prep techniques, adhesive protocols, digital tools, and the future for minimally invasive prosthodontics.

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Introduction

Esthetic prosthodontics is a dynamic and fast growing area of restorative dentistry with the growing demand from patients for restorations that are not only functional but are also indistinguishable from natural dentition (Najeeb & Islam, 2025). In the modern era, patients are very conscious about the esthetics of their dentition, affected by social media, digital imaging and increased awareness of esthetics (Abbasi et al., 2022). As a result, clinicians are required to provide restorations with optimal shade matching, translucency, surface texture and anatomical contour, long-term durability and biological compatibility (Narayan, 2024). This demand has brought a significant change in treatment philosophy in the field of prosthodontic practice (Bhagat et al., 2026).

Historically, prosthodontic restoration was based on mechanical principles of retention and resistance form (Miličić-Lazić et al., 2020). Full-coverage crowns with heavy axial and occlusal reduction were believed to be the gold standard for restoration of structurally compromised teeth (Abu-Awwad et al., 2025). The main

goal was to provide enough space for restorative materials and achieve the mechanical stability, sometimes at the cost of significant structures of enamel and dentin (Singer et al., 2023). Although these methods yielded comparable acceptable functional results, they sometimes had a deleterious effect on the health of the pulp, reduced the strength of the tooth, and increased the potential for long-term biomechanical failure (Alluhaidan et al., 2024).

With a better understanding of tooth biomechanics, pulp biology and adhesive science, a significant paradigm shift has occurred (Attik et al., 2024). Preservation of the vitality of the pulp and maintenance of residual tooth structure are now realized to be important in determining the longevity of the restoration (Duncan, 2022). Studies has shown that by removing too much dentin, the structural integrity of teeth is weakened and may predispose them to fracture under functional loads (Chen et al., 2023). Consequently, the primary design priorities in modern prosthodontics are conservative preparation formulations that require a minimum of unnecessary tissue removal and at the same time provide structural resilience (Jukić, 2025).

Contemporary esthetic prosthodontics involves the use of biomimetic principles and the goal is to duplicate the natural optical, mechanical, and functional properties of tooth enamel and dentin (Al-Taie, 2025). Biomimetic dentistry focuses on how teeth are restored to imitating as closely as possible their original biomechanical behavior (Zafar et al., 2020). This includes the reproduction of enamel translucency, fluorescence, and opalescence as well as the restoration of the shock absorption properties of dentin. Modern ceramic systems and adhesive bonding techniques enable restorations to become an integrated part of the remaining tooth structure as opposed to separate mechanical entities (Meyert et al., 2025).

Advances in ceramic materials, especially lithium disilicate and high-translucency zirconia have enhanced greatly the ability to achieve life-like esthetics with no reduction in strength. Simultaneously, advancements in adhesive systems allow predictable bonding both to enamel and dentin - decreasing the need for aggressive preparation geometries. The combination of digital technologies such as intraoral scanning and CAD/CAM fabrication adds to the precision even more and facilitates minimally invasive workflows (Li et al., 2025).

This change in approach toward conservative, biologically respectful treatment is in close agreement with the tenets of minimally invasive dentistry and long-term oral health maintenance (Gordon et al., 2022). Rather than just being focused on the immediate restorative outcome, in modern esthetic prosthodontics, emphasis is placed on sustainability, maintenance of natural tissues, and prevention of future complications (Hoseini & Naeeni, 2025). By combining the use of advanced materials, adhesive science and digital innovation, clinicians are now able to provide restorations that are durable, esthetically superior and supportive of long-term tooth vitality (Goodluck).

Evolution of Esthetic Restorative Materials

All-Ceramic Systems

The development of all-ceramic systems was a significant advance in the area of esthetics in prosthodontics (ElGendy & ElSharkawi, 2025). All-ceramic restorations eliminate the metal substructure that is present in traditional restorations (porcelain-fused-to-metal (PFM)) which enhances the transparency and light transmission (Mühlemann et al., 2020). Modern ceramic systems are classified according to their composition and production technique such as glass ceramics, polycrystalline ceramics and hybrid ceramics (Zawrah et al., 2023).

Lithium disilicate ceramics have been widely used because of their good combination of strength and translucency (Vichi et al., 2023). With flexural strength of 360-400 MPa, lithium disilicate restorations can be used for veneers, anterior crowns, inlays and onlays. This allows them to be adhesively bonded and improves fracture

resistance, allowing minimally invasive preparation designs to be used (Utar & Demirtaş, 2023).

Zirconia and specifically high-translucency monolithic zirconia has changed the landscape of posterior restorations. Earlier generations of zirconia were very opaque and were indicated mostly for substructures. However, improvements in optical properties without significant reduction in the mechanical strength of the material have been made in the yttria-stabilized zirconia materials. With flexural strengths often greater than 800 MPa, zirconia offers very high durability whilst allowing for conservative tooth preparation (Jabber et al., 2023).

Hybrid and Resin-Based CAD/CAM Materials

New materials such as hybrid ceramics and resin nano-ceramics have been developed in the recent past, where ceramic networks are reinforced with polymer matrices. Such materials are provided with improved shock absorbing and decreased brittleness than the conventional ceramics. Their elasticity is more like those of the dentin and it may lead to a better distribution of stress and in reduction of any catastrophic fracture. These materials can be used in particular cases of chairside CAD/CAM treatments and minimally invasive restorations (Roman et al., 2026).

Minimally Invasive Prosthodontic Concepts

Preservation of Tooth Structure

Minimally invasive prosthodontics philosophy is based on the idea of saving enamel and dentin at all costs (Hegde, 2024). The preservation of enamel is of particular concern since bonding to enamel can be predicted and the bond is stronger than bonding to dentin. It is not only that the conservative preparation make pulpal trauma less but also increase the long term survival of restorations (Wiegand et al., 2021).

Partial restoration restorations like inlays, onlays and overlays are also becoming a favorite choice over entire crown restoration where sufficient tooth structure is present. Such restorations allow the selective removal of diseased or weaker tooth structure to be done without affecting the sound tissue. An intervention is both biomechanical stability supporting and reducing the risk of tooth fracture (Wang et al., 2022).

Ultrathin Veneers and No-Prep Veneers

Thin layer ceramic veneers of about 0.3 to 0.5 mm thickness have gained popularity as a method of anterior esthetic restoration (Reis et al., 2025). These restorations prove to have a high longevity when they are bonded correctly to enamel. No-prep or minimal-prep veneers maintain the natural tooth morphology with a high degree of improvements in the color, shape, and alignment (Santos et al., 2024). The success of minimally invasive veneer therapy depends on case selection. Occlusal evaluation, availability of enamels and patient specific esthetic demands should be critically measured in order to guarantee predictable results (Falcione et al., 2024).

Adhesive Dentistry and Bonding Protocols

Minimally invasive restorations would not be as successful without the improvements in adhesive dentistry. The contemporary bonding systems permit micromechanical and chemical bonding between the restorative materials and the tooth substrates. Self-etch, etch-and-rinse and universal adhesive system offer flexibility in clinical use (Alyahya, 2024).

The adhesively bonded restorations are more evenly distributed in functional stresses throughout the tooth-restoration interface. This minimises mechanical retention features including long axial reduction or circumferential ferrules in some instances. In addition, surface treatment procedures such as hydrofluoric acid etching of glass

ceramics and airborne particle abrasion of zirconia increase bond strength and clinical survival (Huang et al., 2022).

Digital Dentistry and Technological Integration

CAD/CAM Systems

The computer aided design and computer aided manufacturing (CAD/CAM) systems have revolutionized the procedures involved in prosthodontics. The digital impressions that are collected using intraoral scanners enhance patient comfort and remove the mistakes that are created in the traditional impression materials. The digital data is then utilized to make restorations in a high level of precision. Chairside milling units are used to allow same-day restorations, which saves on time taken in treatment and increases patient satisfaction. CAD / CAM systems that are based in the laboratory enhance the uniformity and fit of indirect restorations (Huang et al., 2022).

Digital Smile Design and Esthetic Planning

Digital smile design (DSD) enables practitioners to assess the facial features, lip movements and dental ratios within a virtual setting. This will increase communication with patients and predictability of the treatment. Clinicians can have a more precise match between patient expectation and clinical outcome by seeing what is proposed to occur before treatment (Xuebo, 2025).

Artificial Intelligence and Emerging Innovations

Digital prosthodontics is becoming more and more incorporating artificial intelligence. Margins are detected with the assistance of AI, the analysis of occlusiveness, and how restorations are designed, which is more efficient and reduces human error. With the further development of machine learning algorithms, personalized prosthodontic planning can be more efficient and foreseeable (Syed et al., 2026).

Periodontal and Biological Considerations

Modern esthetic prosthodontics is concerned with reverence towards biological principles. To preserve periodontal health, preserving the biologic width, adequate emergence patterns, and atraumatic placement of the margins is also necessary. Whenever possible, supragingival margins are preferable because they decrease the deposits of plaque and inflammation of the gingiva. Minimal invasive margins are also in favor of the better soft tissue stability and esthetic success in the long term. The combination of periodontal and prosthodontics planning will guarantee harmonious results to balance the functionality and esthetics (Khan, 2021).

Patient-Centered and Interdisciplinary Approach

A combination of prosthodontists, periodontists, orthodontists, and dental technicians is a common requirement of modern esthetic rehabilitation. Interdisciplinary planning enables a holistic approach of treatment referring to functional, esthetic factors and biological factors (Sen et al., 2025). Through patient-centered care, it is possible to consult patients, provide digital previews, and involve them in decision-making. The knowledge of patient expectations, lifestyle, and financial issues improves patient satisfaction and adherence in the long term (Ebadollahi Novin, 2024).

Future Directions in Esthetic Prosthodontics

The future of the esthetic prosthodontics is in bioactive materials, improvement of ceramics with nanotechnology, and complete digital treatment ecosystems. Studies on self-healing materials, enhanced zirconia translucency and regenerative modalities can further reduce the invasive operations. Furthermore, the development of 3D printing can increase the use of the technology in provisional restorations, implant prosthetics, and tailored frameworks. With the ongoing development of technologies,

it is quite possible that the treatment of prosthodontics will be more accurate, efficient, and biologically sparse.

Conclusion

Modern esthetic prosthodontics is an indication of a paradigm shift in the direction of minimally invasive, biologically conscientious treatment philosophies that rely on the advanced materials and digital technologies. A combination of high-performance ceramics, adhesive bonding procedures, and digital process facilitates the clinician to deliver better esthetic results without damaging the natural tooth structure. With the ongoing advancements in materials science and digital technologies, the discipline will be even more consistent with the principles of biomimicry, patient-centered care, and long-term preservation of oral health.

References

- Abbasi, M. S., Lal, A., Das, G., Salman, F., Akram, A., Ahmed, A. R.,...Ahmed, N. (2022). Impact of social media on aesthetic dentistry: General practitioners' perspectives. *Healthcare*,
- Abu-Awwad, M., Halasa, R., Haikal, L., El-Ma'aita, A., Hammad, M., & Petridis, H. (2025). Direct restorations versus full crowns in endodontically treated molar teeth: A three-year randomized clinical trial. *Journal of Dentistry*, 156, 105699.
- Al-Taie, T. H. K. (2025). Future Directions in Restorative and Aesthetic Dentistry: Innovations, Digital Advancements, and Biomimetic Approaches. *Central Asian Journal of Medical and Natural Science*, 6(3), 982-991.
- Alluhaidan, T., Qaw, M., Garcia, I., Montoya, C., Orrego, S., & MELO, M. (2024). Seeking Endurance: Designing Smart Dental Materials for Tooth Restoration.
- Alyahya, Y. (2024). A narrative review of minimally invasive techniques in restorative dentistry. *The Saudi Dental Journal*, 36(2), 228-233.
- Attik, N., Richert, R., & Garoushi, S. (2024). Biomechanics, Bioactive and Biomimetic philosophy in restorative dentistry— Quo vadis? *Journal of Dentistry*, 148, 105036.
- Bhagat, T. V., Gupta, V., Nagpal, R., Heda, A., Khandelwal, A., Alokla, M.,...Zaman, M. U. (2026). Bridging Material Science and Clinical Longevity: A Comprehensive Review of Properties, Selection, and Translational Relevance of Contemporary Dental Restorative Materials. *Bangladesh Journal of Medical Science*, S78-S88.
- Chen, S., Arola, D., Ricucci, D., Bergeron, B. E., Branton, J. A., Gu, L.-s., & Tay, F. R. (2023). Biomechanical perspectives on dentine cracks and fractures: implications in their clinical management. *Journal of Dentistry*, 130, 104424.
- Duncan, H. F. (2022). Present status and future directions—Vital pulp treatment and pulp preservation strategies. *International Endodontic Journal*, 55, 497-511.
- Ebadollahi Novin, M. (2024). A multidisciplinary approach in the planing of complex oral rehabilitation [Sveučilište u Zagrebu, Sveučilište u Zagrebu Stomatološki fakultet].
- ElGendy, M. A. E., & ElSharkawi, N. M. (2025). A Review on the Evolution of CAD-CAM Materials in Fixed Prosthodontics Regarding Mechanical Properties, Aesthetic Outcomes, and Clinical Indications. *ERU Research Journal*, 4(2), 2595-2629.
- Falcione, D., Pena, C., Turssi, C., França, F., do Amaral, F., Tagami, J., & Basting, R. (2024). Influence of application modes on increasing bond strength longevity of self-etching and universal adhesive systems to enamel. *Operative Dentistry*, 49(1), 52-64.
- Goodluck, E. *The Art and Science of Esthetic Dentistry: Balancing Functionality and Aesthetics in Modern Practice*.

- Gordon, S., Riedy, C., Stohler, C., & Vujicic, M. (2022). Trends in scope of practice for oral health care: future transformative effects. *JDR Clinical & Translational Research*, 7(1_suppl), 31S-39S.
- Hegde, S. (2024). Application of Modern Technology in Minimal Invasive Dentistry- A Narrative Review. *J. Electrical Systems*, 20(6s), 2716-2723.
- Hoseini, M. S., & Naeeni, S. K. (2025). Aesthetic Considerations in Prosthodontics: A Literature Review. *Journal of Oral and Dental Health Nexus*, 2(1), 27-39.
- Huang, L., Nemoto, R., Okada, D., Shin, C., Saleh, O., Oishi, Y.,...Miura, H. (2022). Investigation of stress distribution within an endodontically treated tooth restored with different restorations. *Journal of Dental Sciences*, 17(3), 1115-1124.
- Jabber, H. N., Ali, R., & Al-Delfi, M. N. (2023). Monolithic zirconia in dentistry: Evolving aesthetics, durability, and cementation techniques—an in-depth review. *Future Dental Research*, 1(1), 26-36.
- Jukić, A. (2025). Functional aspects of esthetic fixed prosthodontic therapy.
- Khan, S. (2021). Periodontal prosthodontics: Restoring oral function and esthetics. *Periodontal Advancements: A Guide to the Latest in Gum Health*, 160.
- Li, B., Ai, R., Chen, X., Wang, Y., Pan, C., Song, S.,...Liu, X. (2025). Multiscale Design of Dental Restorative Materials: Mechanistic Foundations, Technological Innovations, and Clinical Translation. *Advanced Science*, 12(48), e11258.
- Meyert, A., Fuchs, F., Günther, E., Reissmann, D. R., & Koenig, A. (2025). Translucency, opalescence and fluorescence of human teeth in relation to the storage time after extraction. *Journal of Dentistry*, 106210.
- Miličić-Lazić, M., Marković, J., Popović, D., & Lazić, V. (2020). Treatment planning in implant-prosthodontics: Prosthodontic aspect. *Stomatoloski glasnik Srbije*, 67(3), 144-153.
- Mühlemann, S., Lakha, T., Jung, R. E., Hämmerle, C. H., & Benic, G. I. (2020). Prosthetic outcomes and clinical performance of CAD-CAM monolithic zirconia versus porcelain-fused-to-metal implant crowns in the molar region: 1-year results of a RCT. *Clinical Oral Implants Research*, 31(9), 856-864.
- Najeeb, M., & Islam, S. (2025). Artificial intelligence (AI) in restorative dentistry: current trends and future prospects. *BMC Oral Health*, 25(1), 592.
- Narayan, R. (2024). Biocompatible Restorative Materials: innovations for aesthetic and durable outcomes. *Journal of Dental Care*, 1(1), 53-59.
- Reis, J. M. d. S. N., Pansani, T. N., Del'Acqua, M. A., & Abi-Rached, F. d. O. (2025). Minimally Invasive Ceramic Laminate Veneers for Maxillary Anterior Esthetic Rehabilitation: A 12+ Years Follow-Up. *Journal of Esthetic and Restorative Dentistry*, 37(10), 2171-2179.
- Roman, T., Kharouf, N., Calinescu, M. D., Cournault, B., & Etienne, O. (2026). Who Are the Hybrid Ceramics? A Bibliometric Review. *International Journal of Prosthodontics*, 39(1).
- Santos, M. J. M. C., Zare, E., McDermott, P., & Santos Junior, G. C. (2024). Multifactorial contributors to the longevity of dental restorations: an integrated review of related factors. *Dentistry journal*, 12(9), 291.
- Sen, M. P., Singh, V., & Kale, P. (2025). Interdisciplinary approaches in modern dentistry: A comprehensive review. *Journal of Orofacial and Health Sciences*, 11(3), 107-111.
- Singer, L., Fouda, A., & Bourauel, C. (2023). Biomimetic approaches and materials in restorative and regenerative dentistry. *BMC Oral Health*, 23(1), 105.
- Syed, N., Bibi, H., & Liaqat, S. (2026). Artificial Intelligence and Digital Workflow Innovations in Prosthodontics. *Pakistan Journal of Medical & Cardiological Review*, 5(1), 504-513.

- Utar, M., & Demirtağ, Z. (2023). Comparison of Translucency and Flexural Strength of Zirconia Reinforced Lithium Silicate, Zirconia and Lithium Disilicate. *HRU International Journal of Dentistry and Oral Research*, 3(2), 99-103.
- Vichi, A., Zhao, Z., Mutahar, M., Paolone, G., & Louca, C. (2023). Translucency of lithium-based silicate glass–ceramics blocks for CAD/CAM procedures: a narrative review. *Materials*, 16(19), 6441.
- Wang, B., Fan, J., Wang, L., Xu, B., Wang, L., & Chai, L. (2022). Onlays/partial crowns versus full crowns in restoring posterior teeth: a systematic review and meta-analysis. *Head & face medicine*, 18(1), 36.
- Wiegand, A., Lechte, C., & Kanzow, P. (2021). Adhesion to eroded enamel and dentin: systematic review and meta-analysis. *Dental Materials*, 37(12), 1845-1853.
- Xuebo, L. (2025). The role of digital smile design in enhancing aesthetic dentistry outcomes. *Peta International Journal of Public Health*, 2(2), 1-13.
- Zafar, M. S., Amin, F., Fareed, M. A., Ghabbani, H., Riaz, S., Khurshid, Z., & Kumar, N. (2020). Biomimetic aspects of restorative dentistry biomaterials. *Biomimetics*, 5(3), 34.
- Zawrah, M. F., Taha, M. A., & Youness, R. A. (2023). Advanced ceramics: stages of development. In *Advanced Ceramics* (pp. 1-46). Springer.