

Transforming smiles: Aesthetic rehabilitation with layered zirconia veneers and crowns for spaced dentition and faulty crowns—A case report

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Abstract

The objective of this case report was to provide a plan for aesthetic rehabilitation of a patient utilizing layered zirconia restorations to produce a homogeneous, pleasing smile. In this case, a female patient, aged 38 years, presented in dental clinic with a spaced dentition and faulty crowns that were causing functional and aesthetic concerns. She was a banker by profession and socially active. The treatment plan involved layered zirconia indirect restorations to enhance her natural teeth appearance. The aim of this case report was to propose an effective strategy for addressing her concerns, with the potential to achieve a desired aesthetic outcome. Additionally, the implementation of this treatment approach had a positive influence on self-esteem and confidence of the patient.

Keywords

Aesthetic, dental rehabilitation, layered zirconia, dental veneers, dental crowns, spaced dentition

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Introduction

In modern times, the desire for an attractive smile has become a priority for the general population, surpassing the importance of functional and healthy oral structures. This has led to a significant growth in the field of aesthetic dentistry, which encompasses various specialties, including restorative dentistry, orthodontics, periodontology, prosthodontics, and maxillofacial surgery.¹ The progress in contemporary techniques and dental materials has enabled the achievement of both functional and aesthetic oral tissues.²

Aesthetic dentistry procedures are commonly recommended by dental practitioners to enhance the appearance and improve alignment, shape, and color of teeth. These procedures include teeth whitening and direct and indirect restorations such as crowns, bridges, and veneers. Dental veneering is a specific type of restoration that covers the labial or lingual surface of a tooth. The veneer is bonded to the prepared facial surface, effectively covering the required area.³ Veneering is indicated for discoloration that cannot be treated by other methods such as scaling, polishing, bleaching, or teeth whitening, as well as dental trauma, dental wear, morphological abnormalities, minor

malpositioning, and repairing fractured crown and bridge facings.⁴ Veneers have been a viable treatment option since their introduction in 1983 due to their aesthetics, strength, longevity, conservation, and biocompatibility.⁵

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Dental ceramics, metals, types of cement, and dental composites are the commonly applied restorative materials to fabricate crowns, veneers, inlays, onlays, and dental bridges.^{6,7} Composites have been widely used as dental filling materials for nearly 50 years, serving as an aesthetic alternative to amalgam restoration. They offer superior aesthetic properties with a wide range of shades, translucencies, compositions, viscosities, and curing modes. Additionally, composites possess improved mechanical properties, allowing procedures to be performed with minimal removal of healthy dentin and mimicking the optical properties of natural teeth. This makes them suitable for restoring both anterior and posterior teeth.^{8,9} However, composite resins have some drawbacks, including polymerization shrinkage, discoloration over time, technique sensitivity, and a lack of sufficient scientific evidence regarding their durability.¹⁰ Over time, increased marginal gap formation and fractures within the material have also been observed.¹¹ In cases of larger restorations, indirect techniques using ceramics and metals are considered alternatives to address these issues.^{12–15}

Indirect ceramic restorations offer superior longevity, marginal integrity, strength, wear resistance similar to dental enamel, higher fracture resistance, compressive strength, elastic modulus, and anatomic resemblance, superior to resin composite restorations.^{16–18} Furthermore, metal-ceramic restorations have long been considered the gold standard for crowns and bridges due to their long-term clinical success. However, the demand for metal-free restorations like zirconia has increased due to their superior aesthetics.^{19,20}

Zirconia is a suitable choice for prosthetic rehabilitation in crowns and veneers due to its white color, adaptability, exceptional fracture resistance, and flexural strengths greater than 1000 MPa.²¹ However, a significant drawback of zirconia restorations is the compatibility of overlying porcelain. Concerns like porcelain chipping, cracking, delamination, and fractures are reported with such restorations. Therefore, further improvements are warranted to enhance the wear and optical characteristics of zirconia substructure restorations.²² In this regard, zirconia made with computer-aided design and computer-aided manufacturing technology has significantly reduced overlying ceramic fractures and chipping. A multilayer covering technique is used to veneer zirconia frameworks with compatible ceramics to achieve an aesthetic appearance, with materials such as E-Max[®] (Ivoclar, USA) being a popular choice among dentists due to their resistance to cracking and having a high translucency that mimics natural teeth.^{23,24}

Additionally, provision of a tissue-friendly prosthesis is mandatory in increasing periodontal health. Restorations that impinge the gingiva and promote plaque and calculus formation may lead to severe periodontitis.^{25,26} As there is an existence of oral and systemic health association, periodontitis may lead to cardiac, gastrointestinal, and neurodegenerative disorders due to microflora from the oral cavity.^{27,28} Therefore, a coordinated and comprehensive approach is

required to achieve a balance between aesthetics and functionality by addressing all these factors.^{29,30} In this case, aesthetic rehabilitation using the zirconia veneers and crowns has been adopted to avoid gingivitis and periodontitis by preserving the biological width, as equigingival margin of restorations was planned. For the optimal outcome, patient selection is necessary; in this aspect, vulnerable patients, that is, those with parafunctional habits, mental disorders, mobile teeth, extensive caries, and chronic mucosal conditions, should be screened prior the restorations. Moreover, to ensure the success of restoration and satisfy the patient, it is essential to achieve proper integration of the materials used, carefully plan a tooth preparation, apply reliable bonding techniques, and maintain accurate work authorization with the dental technician.

The aim of this case report was to suggest a suitable material and a treatment plan for restoring anterior teeth that produces an aesthetic smile as well as enhances patient self-confidence and overall well-being. This case report provides evidence of the practicality and acceptance of using layered zirconia crowns and veneers in patients. It also emphasizes the advantages of this approach in achieving both functional and aesthetic improvements in teeth. These findings could be valuable for dental professionals considering the use of layered zirconia restorations in their practice and for patients seeking dental restorations.

Case description

A female patient, aged 38 years, unmarried, came to the prosthodontic clinic with the complaint of spaced anterior teeth and faulty crowns. She was a banker by profession and concerned about her teeth appearance. On history, she had a gingival hyperplasia for which a gingival rehabilitation surgery was performed 3 months back. Patient had also undergone endodontic treatment for her carious teeth. Currently, she has no comorbidities or medications. Moreover, her mother was diabetic. Patient was not habitual eating betel nuts, betel quid, having alcohol, or smoking, and her vitals were normal. Extraoral examination revealed a combination of squarish-ovoid facial form with a straight facial profile. The mouth opening was 42 mm with no deviation of the mandible. The lip thickness was full, and the curvature was curved upward. She had a high lip line and a consonant smile arc. Intraoral examination revealed spaced maxillary anterior teeth and faulty crowns on endo-treated #14, #15, and #25 teeth. (Figures 1–3). The faulty crowns were made of porcelain fused to metal with supragingival margins. She also had a retained deciduous canine on the upper left quadrant, tooth number 63 (Figure 3), which was restored with a dental composite. The arch form was U-shaped in both maxilla and the mandible. Patient had a canine-guided occlusion on both sides of the arch.

The layered zirconia veneers and crowns were planned for the rehabilitation of her anterior and posterior teeth,



Figure 1. Anterior spaced dentition.



Figure 2. Faulty crowns on 14, and 15.



Figure 3. Deciduous 63 and faulty crown on 25.

respectively. As a first choice, orthodontic tooth correction was recommended to the patient for management of spaces and, later on, replacement of faulty crowns, but the patient refused to undergo fixed orthodontics. The patient wanted to improve the morphology and color of her anterior teeth.

Before proceeding with the restoration, a smile design procedure was done and a diagnostic mock-up was made as a reference for discussion with the patients about the future teeth appearance and possibilities (Figure 4). The procedure was carried out by taking the extraoral and intraoral photographs, careful assessment of the diagnostic cast, obtaining the accurate occlusal record and fabrication of the diagnostic



Figure 4. Diagnostic mock-up.

mock-up. The extraoral photos consisted of full-face photos, with lips at rest and smiling, while the intraoral photographs consisted of frontal and lateral views. In addition to this, pocketing depth, gingival, and bleeding index were also measured; all these factors helped in making the decision of margin placement. To avoid biological width violation and to promote easy cleaning of the restoration, equigingival margins were designed. The irreversible hydrocolloid (Zhermack, Badia Polesine, Italy) was used for diagnostic impressions. The mock-up was shown to the patient, and approval was ensured. Shade selection was done by selecting the desired B1 shade in the incisal and middle one third, and for cervical part of the restoration, B2 shade was selected with VITA® Classical shade guide (Zahnfabrik, Bad Sackingen, Germany). This procedure was followed by the classic zirconia veneer preparation with an incisal overlap of 0.5mm on the teeth #11, #12, #13, #21, #22, #63, #24, and the zirconia crown preparations were performed on the teeth #14, #15 and #25 respectively (Figures 5–7). The chamfer margins were designed for veneers, while shoulder margins for the crowns. Chamfer margins were prepared using a tapered round diamond and round-end fissure burs, whereas the tapered fissure diamond bur with a flat end (Mani Inc. Tochigi, Japan) was used to create shoulder margins.

After the preparations, a temporary bridge, Tempron® (GC Corporation, Tokyo, Japan), from #15 to #25, was made chair-side with a putty index (Figures 8 and 9). The impression for the definite restorations was made in polyvinyl siloxane impression material (3M ESPE, EXPRESS STD, St. Paul, MN, USA) (Figure 10). Following the fabrication, the try-in was done to check the fit and shade (Figure 11). For the determination of shade accuracy either a resin



Figure 5. Veneer preparations (front).



Figure 6. Veneer and crown preparations (right side).



Figure 7. Veneer and crown preparations (left side).

composite or a water-soluble try-in paste was used for correct placement of veneers and crowns initially.

In this case, zirconia was bonded both micromechanically and chemically. Micromechanical adhesion was achieved following the different surface treatments while chemical adhesion occurred by using the resin-based adhesive cement. First, the restoration was etched by applying a hydrofluoric acid,

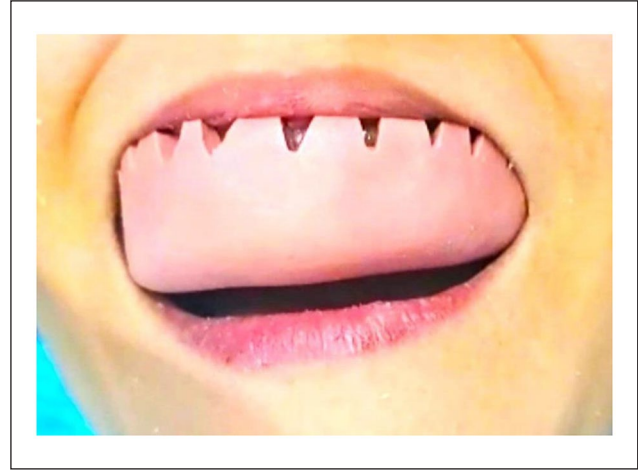


Figure 8. Chair-side technique for providing temporization by using a putty index.

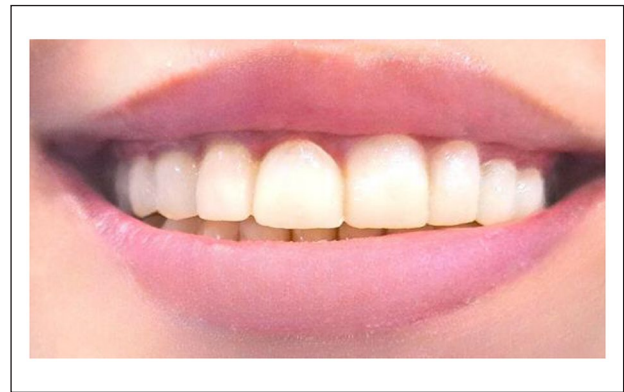


Figure 9. Temporization in the form of a temporary bridge.

rinsed, dried, and then a layer of 10-methacryloyloxydecyl dihydrogen phosphate (10-MDP) primer was applied on inner surfaces. The teeth surfaces were cleaned using oil-free pumice paste. Then, plastic Mylar[®] Matrix Strips (DuPont Teijin Films, China) were placed interproximally. Teeth were etched by applying a 37% phosphoric acid gel, rinsed, and dried thoroughly (Figure 11). The bond was applied and cured, and the separate veneers and crowns were cemented using the dual-cure adhesive resin cement Metacem[®] (Meta Biomed Co., Ltd. South Korea) (Figure 12).

The zirconia veneers and crowns, in this case, were fabricated considering the patient's existing canine-guided occlusion. The occlusal contacts were established, taking into account the guidance provided by the canines during jaw movements, in order to distribute occlusal forces evenly and reducing the risk of wear, fractures, or complications. The fabrication process involved careful planning and communication between the prosthodontist, dental laboratory, and the patient to ensure accurate fit and proper functioning within the existing occlusion (Figure 13).



Figure 10. Final impression.



Figure 11. Try-in of veneers and crowns.

Outcome and follow-up

After the cementation, occlusal adjustments were made where necessary, and oral hygiene instructions, including flossing, brushing techniques, and water pick, have been advised. The first follow-up was performed after 24 h of cementation. Since then, she was monitored after 15 days, 1 month, and 3 months up to the 6 months. After 15 days of cementation, she felt sensitivity in her vital anterior teeth, for which fluoride gel therapy was recommended. The patient conveyed full contentment and expressed delight with the aesthetics and function of the ultimate dental restorations.



Figure 12. Etchant was applied.



Figure 13. Cementation of layered zirconia veneers and crowns.

Discussion

In today's global landscape, there is an undeniable and escalating demand for aesthetic improvements, driving the need for advancements in dental techniques and materials.³¹ For the replacement of missing teeth, spaced or worn-out dentition, patients are striving hard to get a prosthesis that gives them a realistic appearance. There are several options available, which include dentures, crowns, bridges, core buildups, implants, or veneers. With the rising aesthetic expectations and a preference for minimally invasive procedures, veneers have become a popular choice among patients seeking conservative yet transformative dental restorations.³² Hence, the purpose of this case report was to report the management of spaced anterior dentition and the posterior faulty crowns with the layered zirconia veneers and crowns. The rehabilitation of the affected dentition resulted in achieving a consistent, homogenous, and natural smile for the patient, where all

the elements, the color, shape, and alignment, blended well together without noticeable variations or discrepancies. Furthermore, the successful aesthetic rehabilitation increased the patient's morale positively. Utilizing layered zirconia and employing a comprehensive treatment approach, the outcome surpassed the patient's expectations, enhancing both their oral health and overall satisfaction. This exemplifies the efficacy and potential of contemporary dental techniques in achieving optimal functional and aesthetic results.

Layered zirconia consists of a zirconia core, which possesses exceptional mechanical and biological properties. However, to achieve optimal aesthetics, the outer surface of zirconia requires veneering with a highly aesthetic ceramic material, particularly in the aesthetic zone of the natural dentition.³³

The treatment plan for the presented case was carefully developed, considering multiple factors and critical reasoning. A key consideration was the patient's desire for improved aesthetics, which guided the selection of layered zirconia veneers and crowns. Despite the exceptional mechanical and biological properties of zirconia, its inherent aesthetic limitations compared to natural teeth were recognized. To overcome this, the decision to veneer the outer surface of the zirconia restorations with a highly aesthetic material was made. Tooth preparations were meticulously determined based on a thorough analysis of the patient's dental condition and desired outcome. Precise veneer preparation measurements were employed for the anterior teeth to ensure optimal fit and aesthetics. As mentioned above, this patient had a high lip line and a gingival hyperplasia, which had been rehabilitated 3 months back from a periodontist; an accurate margin placement of prosthesis was crucial. Therefore, to avoid marginal gingivitis and periodontitis, equigingival margin placement was planned. This is true with the fact that the subgingival margins tend to cause violation of the biological width, which results in periodontitis, plaque accumulation, and more trauma to the gingival health.³⁴⁻³⁶ The incorporation of incisal edge overlap not only enhanced natural translucency but also facilitated precise seating of the veneers during cementation. In addition, the thickness of layered zirconia can indeed have an impact on the restorability of a tooth when used for a veneer. A balance needs to be struck between having enough thickness for strength and not being too thick, which might affect the translucency and natural appearance of the veneer. Therefore, layered zirconia veneers were fabricated with 0.5 mm thickness. This is also evident with the results of a study conducted by Carlos A. Jurado³⁷ that 0.5 mm thick veneers are more translucent. In the case of the premolars, comprehensive reduction was performed to accommodate the layered zirconia crowns while maintaining appropriate occlusal relationships. Both the present case and a study by Moreira et al.²³ adopted a treatment approach for addressing aesthetic concerns in patients. Both studies utilized zirconia restorations, taking into account the material's mechanical properties and the need for improved

aesthetics. Tooth preparations in both cases were carefully determined, considering individual patient analysis and incorporating features like incisal edge overlap. The thoughtful rationale applied in both studies emphasized a comprehensive treatment plan tailored to achieve harmonious and natural-looking results while considering patient preferences and long-term durability.

The process of cementation of zirconia is of considerable importance. Due to the polycrystalline behavior of zirconia, achieving a strong and durable bond is a challenge. Fully sintered zirconia lacks the glass phase that is essential for the traditional acid etching process that promotes chemical bonding. To address these challenges, researchers and dental manufacturers have developed alternative methods and materials to improve the bonding of zirconia, which includes air abrasion, zirconia primers, or resin cement. Recently, the introduction of a new 10-MDP salt as a cleaner and adhesion promoter for zirconia represents an advancement in the field of dental materials and adhesion.³⁸ Its cleaning property may involve removing contaminants or residues from the zirconia surface, preparing it for optimal bonding. Meanwhile, the adhesion-promoting aspect involves enhancing the interaction between the zirconia and the adhesive material. In this case, before applying a 10-MDP primer, zirconia surface was etched with hydrofluoric acid that helped in creating micro-retentions on the surface, enhancing mechanical bonding.

Moreover, the significance of utilizing various types of veneers and crowns in addressing diverse dental issues is highlighted in the literature, as evidenced by several studies conducted by researchers in the field. For instance, Aminah M. El Mourad³⁹ used ceramic veneers for the masking of severe dental fluorosis. Ana Teresa Maluly-Proni⁴⁰ utilized the laminate veneers for the closure of diastema in a 32-year-old girl. Rodrigo Othavio Assunção Souza⁴¹ closed the unfavorable spaced dentition with the ultra-thin monolithic zirconia veneers. Similarly, André Moreira²³ did the aesthetic rehabilitation of a bruxism patient with ceramic veneers and overlays along with the combination of four-point monolithic zirconia crowns. The author first stabilized the occlusion by placing the monolithic zirconia crowns on molars and canines on both the arches. Then, the aesthetic rehabilitation of anterior and posterior teeth was done with ceramic veneers and overlays, respectively. In conclusion, the diverse range of commercially available materials provides numerous options for achieving aesthetic rehabilitation in dental treatments.

This case report does have certain limitations, and one of them is the potential risk of ceramic fracture in posterior teeth when using layered zirconia due to masticatory forces. To address this, it may be advisable to consider using monolithic zirconia crowns for premolars and molars instead, as they offer greater strength and resistance to occlusal forces. By combining monolithic zirconia in the posterior region and layered zirconia in the anterior region, a more suitable and durable treatment plan can be implemented.³³ Furthermore,

the patient's limited follow-up duration of 6 months hinders a comprehensive assessment of long-term outcomes and durability of the restorations, potentially underestimating future complications and longevity. Additionally, the uniqueness of each case, including variations in oral health, patient compliance, and anatomical factors, may restrict the generalizability of the findings to other similar cases, limiting the applicability of the treatment approach.

This case report offers valuable strengths and benefits. It serves as a guideline for dental practitioners, particularly those involved in aesthetic dentistry, providing insights on how to restore a patient's smile with homogenous aesthetic restorations. The report also aids readers in understanding the handling and bonding procedures associated with layered zirconia prosthesis. This case report stands out due to its comprehensive approach, encompassing various aspects of treatment, from materials to techniques and patient care. It provides practical insights and recommendations, empowering clinicians to apply layered zirconia in aesthetic rehabilitation. The focus on achieving optimal functional and aesthetic outcomes contributes to the scientific evidence in the field and inspires further research for enhancing the longevity and properties of zirconia restorations.

Conclusion

The use of layered zirconia in the aesthetic rehabilitation of a spaced dentition and faulty crowns offers a multitude of benefits, i.e., aesthetic appeal due to layering technique, durability and strength, biocompatibility, versatility, and reduced ceramic fracture. This comprehensive report serves as a valuable resource for dentists, guiding them in delivering a homogenous smile to patients affected by abnormalities in anterior dentition. However, the success of the treatment relies on factors such as developing a precise treatment plan, considering the complexity of the case, ensuring proper maintenance of the prosthesis, and the patient's adherence to post-treatment care and instructions.

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Author contribution

A.H. and N.A. contributed to Conceptualization; N.A. contributed to methodology; H.A., U.B., and H.S. contributed to software; A.H. and N.A. contributed to validation; A.H. contributed to formal analysis; N.A., H.A., U.B., and H.S. contributed to investigation; N.A. and H.S. contributed to resources; N.A., H.A., and U.B. contributed to data curation; H.A., U.B., and H.S. contributed to

writing—original draft preparation; A.H. and N.A. contributed to writing—review and editing; H.A., N.A., A.H., U.B., and H.S. contributed to visualization; A.H. and N.A. contributed to supervision; N.A. contributed to project administration. All authors have read and agreed to the published version of the manuscript.

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Ethical approval

Our institution does not require ethical approval for reporting individual cases or case series.

Informed consent

Written informed consent was obtained from the patient(s) for their anonymized information to be published in this article.

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