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(Case Report)

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Achieving natural aesthetics with zirconia restorations in anterior teeth: A case study

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Abstract

Prosthodontic treatment to achieve natural esthetics in anterior restorations is an essential aspect of modern dentistry. Monolithic zirconia has emerged as the material of choice due to its superior strength, biocompatibility, and enhanced translucency, making it an ideal choice for anterior restorations. This case study discusses the application of monolithic zirconia restorations in anterior teeth to achieve a natural and harmonious smile. A 45-year-old patient presented with esthetic complaints related to dental caries and slight malposition of the maxillary anterior teeth. After a thorough evaluation, monolithic zirconia restorations were selected as the optimal treatment option. The treatment process included careful shade selection, digital planning, and minimally invasive tooth preparation to preserve the natural structure. The final results demonstrated optimal translucency, good shade matching, and high biomechanical strength, ensuring long-term durability and patient esthetic satisfaction. This case emphasizes the importance of material selection and precise clinical execution in achieving natural-looking anterior tooth restorations, providing reassurance about the long-term durability of the treatment and instilling confidence in the procedure's effectiveness.

Keywords: Prosthodontic treatment; Zirconia monolithic; Anterior teeth; Tooth preparation

1. Introduction

The aesthetic rehabilitation of anterior teeth is a significant concern in modern prosthodontic treatment, as patients increasingly demand restorations that closely resemble natural teeth. Metal-ceramic restorations, although durable, often fail to achieve optimal translucency and lifelike appearance. The development of high-strength ceramics, particularly monolithic zirconia, has revolutionized restorative dentistry by offering a combination of superior mechanical properties and improved esthetics(1). Monolithic zirconia has been widely accepted due to its excellent biocompatibility, fracture resistance, and ability to provide metal-free restorations. Recent advances in material technology, such as highly translucent zirconia, have further enhanced its application in anterior restorations, overcoming previous limitations related to opacity. Integrating digital workflows, including computer-aided design/computer-aided manufacturing (CAD/CAM), has significantly improved the precision and predictability of zirconia restorations(2) (3).

Despite these advances, achieving natural esthetics with zirconia in anterior restorations presents several clinical challenges. One primary concern is colour matching, as the inherent opacity of zirconia can sometimes limit its ability to blend with natural teeth, especially in patients with thin gingival biotypes or highly translucent enamel. Surface characterization, including staining and coating, is critical in overcoming these limitations but requires careful technique (4). Another challenge is preparation design, as zirconia restorations require sufficient reduction to ensure strength and translucency. Over-reduction can compromise tooth structure, while under-reduction can result in over-contoured restorations with compromised esthetics. In addition, achieving strong yet esthetic cementation is critical, as the low bond potential of zirconia requires careful surface treatment and selection of appropriate luting agents(5).

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The selection of monolithic zirconia as a restorative material for anterior teeth depends on the patient's strength, esthetics, and clinical conditions. With the advent of high-translucency zirconia and multilayered zirconia, conventional zirconia's esthetic limitations are increasingly being overcome. Zirconia crowns resist occlusal forces and reduce the risk of restoration failure, especially in high-stress areas such as anterior teeth. In addition, marginal adaptation is essential to prevent microleakage and secondary caries, thus ensuring the long-term success of the dental restoration. Studies highlight the superior marginal adaptation of Zirconia crowns by highlighting the precision and accuracy of Zirconia restorations manufactured by CAD/CAM. This tight marginal fit can contribute to better sealing and reduce bacterial infiltration, thereby increasing the durability of the restoration (6).

Tooth colour matching is critical to achieving aesthetic harmony and patient satisfaction in anterior tooth restorations. The higher percentage of acceptable colour matching in Zirconia crowns suggests that Zirconia-based ceramics offer superior aesthetic results to traditional metal crowns. This finding is consistent with the aesthetic benefits reported in previous studies of Zirconia restorations (7). This case report presents a clinical approach to restoring anterior teeth using Zirconia crowns, addressing the challenges of colour matching, preparation design, and cementation to achieve natural esthetic results while ensuring long-term functional stability.

2. Case Report

2.1. Case Description

A 45-year-old female patient came to fix her front teeth. That had dental caries and wanted to be treated with a crown because the previous filling treatment had come off. The patient complained of feeling insecure about her appearance when talking and smiling. The examination showed that teeth 11 and 21 had medial caries on both mesial parts with a diagnosis of reversible pulpitis. Tooth 21 was slightly rotated, so the patient wanted to improve its appearance. The treatment plan in this case was monolithic zirconia crown treatment on teeth 11 and 2.

2.2. Procedure

Restoration of anterior teeth 11 and 21 using monolithic zirconia crowns was performed through several procedural stages to ensure aesthetic and functional success. The first stage is clinical and radiographic evaluation, which aims to assess the condition of hard and soft tissues, carious lesions, pulp vitality, and biological height of the gingiva. Furthermore, the tooth preparation stage was carried out in cervical preparation, namely deep chamfer preparation on teeth 11 and 21 to provide sufficient space for the zirconia material, ensure good adaptation, and avoid excessive stress on the crown structure. This preparation was carried out to improve the biomechanical performance of zirconia restorations (8).

Figure 1 Digital planning and contact checking in the facial direction (a) and incisal direction (b) Zirconia crowns in facial direction (a) and incisal direction (b)

After the preparation, an impression is made using the putty-wash technique to obtain an accurate working model. Before the impression, a gingival retraction paste is placed in the gingival sulcus to temporarily shift the gingival tissue and record the preparation margins. Next, the crown colour is determined using a 3D shade guide to ensure colour matching with the patient's natural teeth. One of the main challenges is the translucency and final colour of the restoration. The monolithic zirconia crown is then manufactured through a milling and sintering process. Although monolithic zirconia has advantages in strength and durability, there are some clinical challenges in its use on anterior teeth (9). The laboratory challenge is an occlusal and interproximal adjustment because zirconia has high hardness and is difficult to adjust after sintering. Excessive correction can cause micro-stress and increase the risk of chipping or fracture of the crown. Therefore, digital planning and contact checking are performed to avoid these complications.

The zirconia restoration model received from the laboratory is examined against the working model to ensure passive fit to the prepared teeth. Good marginal adaptation is essential to prevent microleakage and increase the durability of the restoration. Using dye spacers on the model ensures the restoration is not too tight or loose. Proximal contact examination is performed with dental floss to ensure that the zirconia crown does not have too tight or loose contact with the adjacent teeth. Ideal proximal contact ensures the stability of the restoration and prevents food impaction that can cause gingival irritation. The zirconia restoration model is also evaluated about the opposing teeth to ensure balanced occlusion. The use of articulating paper can help identify excessive occlusal contact points. Examination of passive fit, marginal adaptation, proximal contact, esthetics, and occlusal relationships ensures the restoration will function biomechanically and esthetically well(10).

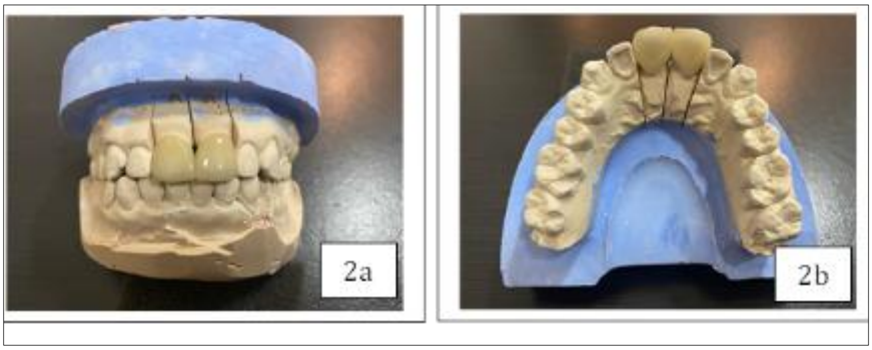

Figure 2 Zirconia crowns in facial direction (a) and incisal direction (b)

Next, bonding and cementation procedures are performed because zirconia has inert properties and low adhesion to resin cement. The zirconia surface requires special pretreatment, such as sandblasting with aluminium oxide particles and applying zirconia primer (MDP-containing primer) to increase adhesion. Preparation before cementing includes cleaning the internal surface of the crown, selecting the appropriate type of cement, and surface treatment to improve retention. The type of cement used in this case is self-adhesive resin cement. After applying the cement to the crown surface, the crown is placed with light pressure, ensuring even distribution of the cement without creating gaps. Excess cement should be cleaned before polymerization or hardening to prevent irritation of the gingival tissue. After cementing, a final evaluation is performed to ensure stability, patient comfort, and occlusal balance. The patient is also given post-insertion instructions, including avoiding hard foods for the first 24 hours and maintaining the restoration's cleanliness to extend the crown's life. With proper insertion technique, zirconia crowns can provide long-term restorations with optimal aesthetics and function.

Figure 3 The final result of zirconia crown insertion on teeth 11 and 21

3. Discussion

The use of monolithic zirconia for anterior tooth restoration is gaining popularity due to its combined advantages in strength, esthetics and biocompatibility. One of the main indications is in patients with high occlusal loads, such as bruxism or clenching, where other restorative materials, such as porcelain-fused-to-metal (PFM) or lithium disilicate (e.max), are more prone to chipping or fracture. Monolithic zirconia, with its denser structure and without additional porcelain layers, offers better resistance to masticatory forces. In addition, this material is the leading choice for full crown restorations in anterior teeth with significant structural loss, such as after endodontic treatment or trauma, because it can maintain structural integrity with minimal risk of material failure (1,11).

Other indications include short bridges on anterior teeth, especially when patients desire a strong restorative material without metal support. Although lithium disilicate offers better esthetics, modern monolithic zirconia, especially high-translucency zirconia and multilayered zirconia, have improved optical properties to mimic the characteristics of natural enamel better. In addition, monolithic zirconia is highly recommended for patients with metal allergies, as it does not contain metal components such as PFM, thus reducing the risk of hypersensitivity reactions and soft tissue inflammation around the restoration (4,5,11).

Another advantage of monolithic zirconia is its ability to be used in patients who require long-term restorations with high durability. Clinical studies have shown that monolithic zirconia has a high success rate in anterior tooth restorations, with a lower risk of failure than other ceramic materials. Therefore, the selection in this case has considered individual patient factors, including occlusal conditions, aesthetic needs, and preferences for more durable and biocompatible restorative materials(12).

Zirconia is highly biocompatible and shows excellent gingival response, making it a good choice for anterior restorations, especially in cases with thin gingival biotypes. Zirconia also has the lowest bacterial adhesion compared to e.max and PFM, thus reducing the risk of peri-implantitis or gingival inflammation. Based on research results, it is known that Zirconia restorations have a survival rate of over 98% in 5 years, especially in posterior cases, but are more dependent on bonding techniques when used in anterior (13).

In this case, the preparation design is a key factor in the success of monolithic zirconia crown restorations on anterior teeth. In contrast to other restorative materials such as porcelain-fused-to-metal (PFM) or lithium disilicate (e.max), zirconia has high strength, allowing for more conservative preparations compared to materials requiring greater minimum thickness. Sufficient reduction of the entire tooth surface is needed to balance retention, fracture resistance, and esthetics. An occlusal or incisal decrease of approximately 0.8–1.5 mm is recommended to provide sufficient space for the restoration without compromising the structural integrity of the remaining tooth (10).

Margin preparation, in this case, dramatically affects the adaptation of the crown and the distribution of occlusal pressure, which uses a shoulder finish line preparation because it can provide optimal support for restorative materials while reducing the risk of stress that can cause fracture. Shoulder finish lines with a depth of about 1.0 mm are used because the case requires superior aesthetics. In this case, sharp corners or uneven edges should be avoided because they can create stress points that increase the risk of restoration failure. With the appropriate preparation design, monolithic zirconia crowns can provide optimal retention, even pressure distribution, and more natural and durable aesthetic results.

Resin cement bonding techniques have become an effective method for placing monolithic zirconia crowns, especially in cases where mechanical retention of the tooth preparation is limited or when stronger adhesion is required to improve the long-term success of the restoration. Unlike glass-based ceramic materials such as lithium disilicate (e.max), which can be etched with hydrofluoric acid and silanized to improve adhesion, zirconia has different chemical properties and requires a special approach. One of the main techniques in zirconia bonding is sandblasting (airborne-particle abrasion) using 50 μm alumina to create a micro retentive surface that enhances the mechanical bond with the resin cement. Studies have shown that sandblasting can improve the shear bond strength between zirconia and resin cement (14).

In addition, since zirconia does not have silica bonds that can react with silane, using 10-MDP (10-Methacryloyloxydecyl Dihydrogen Phosphate) primer is highly recommended before resin cement application. The 10-MDP molecule can form a stable chemical bond with the zirconia structure, thereby significantly increasing the adhesive strength of resin cement. Studies have shown that using primers containing 10-MDP, such as Monobond Plus and Z-PRIME Plus, after sandblasting results in higher shear bond strength compared to no surface treatment(14,15).

After the zirconia surface is prepared, self-adhesive resin cement ensures optimal bond strength, especially in restorations that require high resistance to masticatory forces. The advantages of resin cement bonding include increased marginal stability, better restoration retention, and reduced risk of debonding or micro-leakage, often the main factors of zirconia restoration failure. This technique also allows for more conservative restorations with minimal preparation because the chemical adhesion of the resin cement can replace the need for sizeable mechanical retention. The technique's success is enhanced by controlling humidity during installation and selecting the appropriate adhesive and resin cement system to ensure compatibility with the zirconia. Installation of monolithic zirconia crowns can provide more extended durability and better esthetics than conventional cementation methods(16,17).

Accurate tooth shade selection in monolithic zirconia restorations is greatly influenced by various environmental factors affecting colour perception. Ambient lighting, for example, plays an important role; light sources with different colour temperatures can cause variations in tooth colour perception(18). Therefore, it is recommended that shade selection be performed under standard lighting with a colour temperature of approximately 5500 K to ensure consistency. In addition, the colour of the patient's clothing and the room's walls can also affect colour perception through light reflection. To minimize these effects, using a neutral apron or grey background during the shade selection process is recommended (19,20). Eye fatigue in the practitioner can also affect the accuracy of shade selection; therefore, adequate rest and aids such as shade guides or digital shade-matching devices can help improve accuracy. By considering these factors, practitioners can improve the esthetic success of monolithic zirconia restorations.

4. Conclusion

Successful anterior tooth restoration requires a balance between esthetics, strength, and long-term stability. With its superior mechanical properties and recent advances in translucency, Zirconia has become a viable option for anterior restorations. This case highlights the importance of proper material selection, accurate shade matching, and surface characterization in achieving a natural, lifelike result. Despite its advantages, zirconia presents specific clinical challenges, including shade adaptation, cementation technique, and preparation design. However, achieving optimal esthetics requires careful case selection, meticulous surface finishing, and appropriate cementation protocols.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

The authors have disclosed fully agreed publishing interests without any potential conflicts that may arise later.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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