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Zirconia Crowns as an Advanced Solution for Pediatric Dental Caries: A Comprehensive Review of Biochemical Considerations and Management Approaches

Ibrahim Ahmed Jaber Alnaji[1], Latifa Bakri Yusuf Zeila[2], Naima Hussain Mohammed Alnami[3], Amal Sulaiman Muteb Alkhaldi[4], Rasha Yahya Sheik[5], Halimah Mousa Debaji[6], Salma Ismail Ahmad[7], Ashwaq Awad Alanazi[8], Israa Mohammed Hussain Alwabari[9]

Abstract

Pediatric dental caries is a prevalent issue, necessitating effective restorative solutions. Zirconia crowns have emerged as a promising option due to their superior mechanical properties and aesthetics compared to traditional materials. Understanding the biochemical considerations and management approaches associated with zirconia crowns is essential for optimizing their use in pediatric dentistry.This comprehensive review analyzes recent literature on zirconia crowns, focusing on their composition, mechanical properties, translucency, preparation techniques, and bonding characteristics. A systematic search was conducted across databases such as PubMed, Scopus, and Embase, retrieving studies from 2000 to 2023 that detail advancements in zirconia materials and their clinical applications.The review highlights that monolithic zirconia crowns offer exceptional strength, aesthetics, and biocompatibility, making them suitable for pediatric patients. Advances in zirconia formulations have enhanced translucency and reduced the need for extensive tooth reduction. However, challenges remain in achieving optimal bonding strength due to zirconia's low surface energy. Surface treatments and the use of adhesive cements containing phosphate monomers have shown promise in improving adhesion.Zirconia crowns represent a significant advancement in pediatric restorative dentistry, combining durability and aesthetic appeal. Ongoing research is needed to refine bonding techniques and improve clinical outcomes. The integration of zirconia crowns into pediatric dental practice requires a thorough understanding of their properties and the implementation of effective management strategies.

Keywords: *Pediatric Dentistry, Zirconia Crowns, Dental Caries, Bonding Techniques, Restorative Materials.*

Introduction

An increasing amount of zirconia (Zr) has been produced for several dental therapeutic applications. This is attributable to its enhanced natural aesthetics compared to ceramometal implants and its improved mechanical properties, which are associated with transformation toughening relative with other dental ceramics [1]. Moreover, the fabrication of dental implants is increasingly automated, precise, and time-efficient due to advancements in chairside milling and its integration with state-of-the-art rapid-sintering technology [2].

The first zirconia used in dentistry as "white metal" was "3-mol% yttria tetragonal zirconia polycrystalline" (3Y-TZP), employed in traditional restorations. They are used in conjunction with ceramic veneering as well as structural cores [3]. Traditional zirconium restorations do not possess the translucency of glass-ceramics, despite their significant strength. Historically, the technique of powder-firing ceramic onto a zirconia base was once used to address this aesthetic deficiency [4]. Nonetheless, using this technique renders the repair susceptible to chipping as well as delamination. To mitigate this vulnerability, many procedures were used,

[1] Ksa, Ministry of Health
[2] Ksa, Ministry of Health.
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[4] Ksa, Ministry of Health.
[5] Ksa, Ministry of Health
[6] Ksa, Ministry of Health
[7] Ksa, Ministry of Health
[8] Ksa, Ministry of Health, Dental Clinics Complex East Riyadh
[9] Ksa, Ministry of Health, King Fahad Hospital Alhofuf

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involving the distinct milling of the veneer and structure prior to their amalgamation using resin cement or fused fire. Nonetheless, encasing the Zr core using ceramic veneer would lead to a larger restoration, necessitating the elimination of additional enamel and so compromising the integrity of the abutment tooth. Monolithic Zr was proposed as a remedy to these issues in an attempt to address them [5].

Zhang and Lawn indicate that focused efforts were aimed regarding monolithic Zr repairs to enhance their aesthetic as well as longevity standards, streamline their manufacture, and reduce material thickness needs [6]. Efforts to enhance the translucency and optical properties of Zr mostly focused on modifying the crystal size and matching the refractive indices of the crystalline as well as matrix stages [7,8]. Furthermore, augmenting the yttrium concentration, modifying the grain dimensions, and reducing pollutants proved to be useful strategies for achieving achievement. Consequently, transparent zirconium has been promoted as an appealing treatment option for less invasive veneer repairs [9]. Veneer restorations mostly depend on resin cement adhesion due to their absence of mechanical retention from tooth preparation. In contrary to silica-based glass ceramics, the makeup as well as physical characteristics of exceptionally strong ceramic materials, including zirconium oxide (ZrO_2) as well as aluminum oxide (Al_2O_3), differ significantly, requiring alternate bonding methods to establish a strong, enduring, and durable adhesive bond [7-9].

This review aims to provide general dentists with a comprehensive understanding of the literature regarding advancements in composition, physical attributes, transparency, preparation concepts, and bonding attributes that make these materials suitable for aesthetic veneer restoration.

Search Methodology

A literature search was conducted to identify relevant articles detailing the gradual growth of ultra-translucent monolithic zirconia, as it exists currently and, in the future, reflecting a concerted effort to achieve optimal translucency and strength. Prominent scientific databases such as PubMed, Elsevier, Scopus, as well as Embase were queried to identify relevant English-language literature published from 2000 to 2023.

Development and Corresponding Physical Properties

Zirconium, as a dental corrective substance, has had several breakthroughs and alterations throughout time (Figure 1). In comparison to other ceramic materials, 3Y-TZP, the initial generation of dental zirconia, exhibited superior durability due to the inclusion of a little amount of alumina (Al_2O_3) for sintering advantages [8]. This variant of Zr exhibited restricted translucency due to the presence of non-cubic Zr stages, which caused light reflecting from pores, grain borders, and other elements, culminating in significant opacity and suboptimal optical aspect [6-14]. Consequently, it was mostly used as a supportive structure for fixed dental prosthesis (FDPs) for posterior teeth, owing to its robust flexibility and biological compatibility [8-11].

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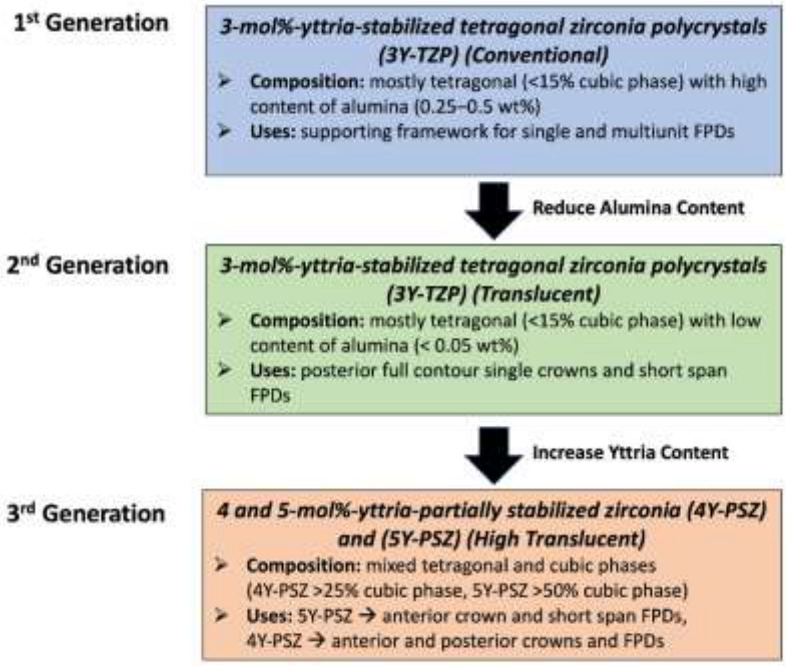

Figure 1. Schematic Representation of the Development and Stages of Yttria-Stabilized Tooth Zirconia.

In 2013, an enhanced variant of the 3Y-TZP components was introduced (Figure 2). This was accomplished by sintering at an elevated temperature to eradicate porosity and by significantly decreasing the quantity of alumina added [15]. The alumina particles were situated at the peripheries of the Zr grains, resulting in increased light transmission [15]. This alteration has enhanced the cosmetic attributes of this generation of Zr, while its use is limited to the posterior region.

The subsequent step in the advancement of monolithic Zr necessitated the incorporation of translucent stages in the final material to enhance its translucency. The translucency of zirconia was enhanced by increasing the yttria (Y2O3) concentration to 5 mol%, resulting in yttria-partially stabilised zirconia (5Y-PSZ) [16]. Cubic Zr is the common designation for this zirconium, characterized by a cubic-tetragonal architecture [14-16]. Approximately fifty percent of the substance is cubic. Light traversing the restorations encounters less edges as well as porosities considering to the greater size of cubic crystals compared to tetragonal crystals. Consequently, it seems more transparent. Nevertheless, mechanical properties like flexible strength and crack resistance deteriorate as the concentration of cubic crystals increases. Consequently, its use is restricted to single tooth repairs in the front portion as well as permanent full denture prostheses (FPDs) including up to three units with one pontic situated among two crowns in the premolar area [6,12-16]. The recommended dosage vary for monolithic zirconia restorations is being broadened via several enhancements designed to optimize material properties. In 2017, alterations to the next generation of Zr were executed by reducing yttria level to 4 mol% (4Y-PSZ) to enhance the mechanical properties relative to 5Y-PSZ from the same generation [6,12-16].

Monolithic zirconium restorations are fabricated with CAD/CAM technology (Computer-Aided Design and Computer-Aided Manufacturing). Sintering and cutting of a singular monolithic zirconium oxide ceramics piece or black are executed using computerized numerical control [17,18]. The fabricated crowns demonstrate enhanced flexural durability and fracture resistance compared to silica-based ceramic crowns (Table 1). Monolithic zirconia ceramic restorations provide superior mechanical properties compared to conventional all-ceramic restorations, enabling them to endure greater chewing forces with a reduced likelihood of shattering [19]. Furthermore, monolithic zirconia crown restorations need less reduction of tooth structure compared to all-ceramic crown restorations, hence conserving natural-looking tooth architecture [20]. Traditional Zr has a modulus of elasticity of 215 GPa and an elastic strength above 1100

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GPa, while the durability of transparent Zr is ascertained to be just half that of traditional Zr, with discrepancies dependent on the producer [9]. Translucent zirconia has been shown to have superior fracture resistance compared to lithium disilicate along with porcelain-veneered repairs, with its ability to bend [9,21-26].

Translucent monolithic zirconium experiences gradual aging, often known as low-temperature degradation (LTD), over time [27,28]. This starts at the material's surface and progressively penetrates to alter the substance's overall properties. LTD will lead to a 20–40% decrease in fracturing stress by increasing surface roughness, inducing microcrack formation, and diminishing the material's mechanical properties. This will occur irrespective of the surface modification used [29]. Multiple factors influence Zr's ability to withstand LTD, such as yttria content, size of grains, cubic stage proportion, Al2O3 and SiO3 concentration, and the extent of residual stress. Research indicates that the concentration of Al2O3 must be maintained at a minimum of 0.15 weight percent, with an appropriate range of 0.15–0.25 mass percent, to inhibit the process of aging [30]. Decreasing the alumina concentration to enhance translucency, however, poses the possibility of elevating the material's susceptibility to LTD. Literature indicates that the monoclinic phase often emerges after the LTD phase, which may lead to decreased fracture resistance in transparent Zr crowns [31-33].

Despite the correlation between increased Y2O3 content and diminished mechanical characteristics in transparent monolithic Zr, Elsayed et al. have shown that the breaking strength of transparent monolithic Zr 5Y-PSZ with elevated Y2O3 remains superior when compared to 3Y-TZP and 4Y-PSZ molar crowns [34]. Conversely, 8 mol% monolithic Zr samples exhibited a much greater susceptibility to strength degradation during mechanical cycling, especially when thermal treatment was included with mechanical cycling [35]. Furthermore, after heat cycling in water, unpainted monolithic crowns exhibited the lowest strength. Bergamo et al. assert that the synergistic effects of mechanical and thermal aging do not significantly diminish the fracture stresses related to the replacement of monolithic crowns of zirconia [36].

Advancements in Color Characteristics and Improved Translucency

The makeup and architecture of zirconia were altered to provide a natural look with optimal translucency. Translucent Zr, similar to normal Zr, also incorporates yttria. Translucent Zr, however, has a higher yttria concentration, that ranges from four percent mol to eight percent mol. Consequently, at ambient temperature, PSZ exhibits both tetragonal as well as cubic stages [37]. As the yttria concentration increases, a segment of the tetragonal state transforms into a cubic phase, resulting in optical isotropy. Translucency is enhanced, and light dispersion at the grain borders is reduced as a consequence [20,21]. The rise in translucency compromised the restoration's flexural strength and toughness. Zhang et al. assert that a rise in yttria level inhibits the cubic Zr from experiencing a stress-induced transition, which would undermine its strength [30].

In recent years, several manufacturers have refined the composition of zirconium to create a polychromatic multilayer, aiming to replicate the shade gradient observed in natural teeth, where the incisal region of the veneer exhibits the highest translucency, gradually rising in chroma and transparency towards the gingival area of the veneer [38]. Initially, pre-shade layers with same Zr composition were fabricated as polychromatic multilayer homogeneous Zr. It has been said that only the pigment content differs across the many layers of this homogeneous multilayer zirconia material, leading to varying hues while maintaining comparable translucency [38]. Subsequently, ultra-translucent zirconia with varying microstructures across the layers was included, including tetragonal zirconia polycrystal (TZP) and partially stabilized zirconia (PSZ) layers with diverse compositions and characteristics, resulting in a polychromatic multilayer hybrid zirconia composition [39]. The layers exhibit varied formulations based on Yttrium concentration and chemical composition, resulting in differing physical characteristics within the material [39]. Numerous producers assert that advancements in various grades of ultra-translucent zirconia have made monolithic translucent zirconia a feasible treatment alternative for the restoration of front teeth via indirect veneer repairs [3,38].

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Total translucency is greatly affected by dispersion, material arrangements, and microstructures [21-23]. Alumina contributes to light scattering in zirconia by altering the refractive index, which diminishes zirconia's translucency; hence, in newer transparent iterations, the alumina concentration has been decreased [23]. Lambert's law states that light transmission increases as thickness decreases due to reduced absorption [40]. Zirconia restorations with a thickness of just 0.5 mm may demonstrate translucency akin to that of lithium disilicate ceramics, which possess a minimum thickness of 1 mm and are regarded as very transparent [8]. The monolithic Zr porcelain has unique optical properties that vary by brand [41]. An in vitro study was performed to evaluate the color of transparent zirconia veneers made of laminate with varying thicknesses applied to teeth of different shades. The color scanning spectrophotometer demonstrates that thinner veneer repairs often exhibit elevated values, implying that such restorations may provide superior color matching [42].

Increased translucency is correlated with thinner transparent zirconia, particularly those about 0.3 mm in thickness [43]. It is essential to assess the final aesthetic of restorations with transparent zirconia, which permits light transmission, by examining the hue of the cement or composite-resin luting agent. To achieve optimal outcomes, it is recommended to use try-in pastes to verify the anticipated look and to choose a cement shade that harmonizes with the color of the adjacent tooth [44].

Numerous investigations have recorded the impact of various parameters on the color as well as optical characteristics of transparent monolithic Zr [19,39]. Nevertheless, there is little understanding of the impact of aging, particularly low temperatures on the transparency of a novel class of transparent Zr ceramics. Subasi et al. examined the influence of thickness as well as material on color in research. The color durability and related transparency properties (RTP) of monolithic zirconia ceramics were assessed during thermocycling in a coffee solution [45]. In the groups with differing thicknesses, the interaction between material and thickness was extremely significant, and a statistically important distinction also existed among them. Kim et al. indicated that hydrothermal aging enhanced the transparency of monolithic zirconia [46].

Architecture of Veneer Preparation, Marginal Fit, as well as Adjustment

Several manufacturers indicate that the width of their transparent monolithic zirconia dental restorative material ranges from 0.3 mm to 0.7 mm, with a minimum thickness of 0.3 mm. Further comprehensive preparation methodologies and information regarding the thickness of transparent monolithic zirconia are still required and ought to be comprised into the literature [47,48]. An exact and meticulous reduction of dental tissue is essential for achieving optimal outcomes with beautiful veneers. Maintaining the longevity and authentic look of the veneers necessitate meticulous and appropriate implementation of this procedure. The tooth's location and function dictate the optimal preparation for monolithic zirconia restorations. Generally, anterior teeth should possess wall thicknesses of no less than 0.3 mm in the range of 1.0 and 1.5 mm. The incisal depth should feature a constant circumferential cut at the gingival edge, measuring at least 0.3 mm, to enable precise grinding of the pre-sintered zirconia.

The design of the veneer preparation is deficient in retentive characteristics, posing a significant obstacle for monolithic zirconia veneer restorations [49,50]. It is essential to acknowledge that several variables affect the preservation of monolithic zirconia restorations. Lepe et al. found in their investigation that zirconia restorations may be sufficiently preserved in a clinical setting with tooth preparations exhibiting optimal taper as well as axial measurement [51]. Further research using a minimally invasive vertical preparing method examined Zr and Zr-reinforced lithium silicate restorations produced by CAD/CAM procedures, which were adhered with dual-polymerizing luting resin throughout a three-year follow-up duration. Both ceramic materials yielded favorable aesthetic outcomes, maintained robust and stable soft tissues, and exhibited no mechanical difficulties [52,53].

The marginal adaptation of monolithic transparent zirconia laminates is affected by the sintering method and the layout of the dental preparation. Diverse marginal designs, such as altered vertical with reversal shoulder, deeper chamfer, and vertical, might affect the failure mechanisms and fracture intensities of monolithic zirconia veneer restorations [54]. Abdulazeez et al. reported that the vertical marginal layout exhibited the lowest fracture stress, whereas the chamfer, following the modified vertical design,

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demonstrated the maximum fracture load [54]. The mean fracture assets of the monolithic zirconia restorations in all groups surpassed the maximum occlusal forces in the premolar area. The fracture strength was enhanced by the vertical prepared modification, which included positioning the opposite shoulder at the buccal area, resulting in no statistically significant distinction between the chamfer category and the placebo group [55,56]. The marginal depths of zirconia veneer repairs will also influence fracture resistance. The decrease in fracture strength was noticeable when the border width was reduced to 0.8 mm, however it was not significantly relevant up to 0.8 mm, according to research examining marginal thickness [57]. A further in-vitro investigation on the fracture-resistant properties of zirconia crowns fabricated by CAD/CAM with varying marginal thickness abutments revealed that a reduction in marginal thickness corresponded with a drop in fracture load value [58].

Saker and Ozcan have demonstrated that the sintering procedure and dental preparation layout influence the marginal adaptability of monolithic clear zirconia [59]. The dental preparation pattern used significantly influences the breaking resistance of transparent zirconia restorations during the sintering process [60]. Jurado et al. reported that the fracture resistance of chair-side ground Zr-reinforced lithium silicate veneers was considerably influenced by the patterns employed in incisal preparation [61]. The incisal palatal chamfer preparation design significantly enhanced the breaking durability of monolithic Zr-reinforced lithium silicate laminate veneers when compared with incisal shoulder preparation or no preparation. This investigation found that adhesive fractures mostly occurred in the incisal maxillary shoulder as well as chamfer [62].

Research by Mohaghegh in 2020 assessed the median gap between two depths of monolithic Zr restorations (0.5 mm and 1 mm), revealing no significant distinction among both groups [49]. The layered Zr crowns exhibited a marginal gap that was much bigger than that of the monolithic Zr veneers. Consequently, they suggested that a 0.5 mm layer of Zr may be used for cosmetic applications without compromising the marginal integrity of the repair [49,62]. Research indicates that the butt junction veneer preparing layout exhibited a much superior marginal fit compared to the maxillary chamfer layout [63]. A recent case report revealed effective therapy following one year of follow-up using ultrathin zirconia veneer replacements on the anterior teeth, with veneer thicknesses varying from 0.3 to 0.6 mm [43]. Case series of two patients who had 0.6 mm thick zirconia veneer restorations on anterior teeth indicate patient satisfaction with the aesthetic outcomes of their treatment. The posterior teeth exhibited minimal discoloration, therefore facilitating the matching of the final shade, despite findings indicating that transparent zirconia restorations yielded exceptional aesthetic results [46].

The resistance and retention of veneers are closely connected to their interior fit. Elevated misfit values increase the likelihood of breakage under strain and diminish retention. A consistent distribution of cement gap throughout the crown mitigates retention loss and potential fracture and is crucial for effective force disposal under oral pressures [63-66]. Various research has shown that the median axial as well as occlusal gap values varied from 57 to 105 μm, but Paul et al. found the average marginal separation value to be 77 μm [64]. Current studies indicate that any discrepancy at the veneer edge should not exceed 120 μm. Some contend that the limitation for CAD-CAM technology should not exceed 100 μm [67]. The ultra-translucent zirconia monolithic veneers exhibit clinically satisfactory marginal as well as internal fit. The production method and different layers of zirconia monolithic veneers are unlikely to substantially influence the marginal as well as internal fit [67].

Adhesive Cement Bonding Properties

The durability of laminated veneer repairs mostly relies on bonding using adhesive cement, since veneer preparations do not possess retentive characteristics. A strong, durable resin cement bond provides adequate retention, improved marginal adaptation, less micro-leakage, and heightened fracture resistance for both the repaired tooth and the restoration. Contemporary all-ceramic implants and bonding agents' methods provide several highly attractive treatment options. Adhering to certain protocols, such as conditioning with hydrofluoric acid accompanied by silanization, facilitates a reliable bonding procedure to traditional silica-based ceramics, yielding enduring results [69,70]. Rehabilitation with zirconia veneers is a significant problem owing to their poor adhesion qualities to resin cement. One reason glass–ceramic

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materials are often used for indirect veneer implants is their ability to establish a chemical bond with resin cement, unlike Zr implants, which are chemically impermeable [69,70]. Consequently, several surface treatments have been proposed to modify the zirconia surface and improve adherence to resin adhesive [71-74]. The methods involve airborne-particle abrasion (APA), tribo-chemical silica airborne-particle abrasive (TBS), laser treatment, plasma sprinkling zirconium ceramic powder covering, low-fusion ceramic usage, hot chemical etching solutions, and selective infiltration etching (SIE) [74].

The use of surface preparation methods enhances mechanical and chemical adhesion. The bonding of zirconia resin may be enhanced and extended by the use of primers and resin cement formulated with phosphate ester monomers or 10-Methacryloyloxydecyl Dihydrogen Phosphate (MDP) monomers as surface pretreatments [74]. These monomers are beneficial due to their potential to form robust chemical connections with the metal oxides in zirconium. Moreover, established research indicates that resin luting agents comprising 10-MDP and airborne-particle attrition are effective methods for attaining long-lasting, robust Zr resin bonding [75]. Study by Blatz et al. indicates that the APC Zr Adhesion Principle is an effective method for establishing robust, long-lasting resin bonds to Zr [76]. The three fundamental processes of zirconia cementation are designated as the APC Zirconia Bonding Concept: Step A involves air-particle abrasion of alumina or silica-coated alumina particles; Step P entails the application of an MDP or phosphate-monomer-based primer to the air-abraded surfaces; Step C consists of the application of dual- or self-cured composite material cement [76]. The material may be effectively reinforced by air-abrading the bonding region of Zr through a sandblaster using tiny alumina grains (50 µm) or silica-coated alumina elements at low pressure. The bonding capacity would be enhanced by applying a Zr primer, including MDP, to the Zr adhesive surface, which would inherently facilitate adhesion with metal oxides. Utilizing dual- or self-cure resin cement is vital to guarantee enough polymerization [69-76].

It is important to note that employing a 0.5 mm light monolithic Zr veneer substance necessitates an increase in the resin composite's curing period by roughly forty percent compared to scenarios without Zr ceramics. Nonetheless, the curing duration must be extended to double its original length if the dimension of the Zr ceramic substance is augmented to 1 mm [77]. A case series with a follow-up period of up to five years has shown a 100% survival rate for ultra-translucent zirconia veneers bonded with adhesion resin cement after undergoing airborne particle attrition and silica polishing. No apparent problems, including debonding, veneer breakage, or secondary caries, were seen [78].

Impact on Opposing Dentition

The most robust ceramic substance used in restorative applications is zirconia (Zr) [79]. Nonetheless, it is crucial to understand that the hardness of a substance does not necessarily mean it would produce higher abrasion on the enamel surface of the opposite tooth [80]. In contrast, many experiments indicated that transparent monolithic zirconia, with its flat polished surface, exerts less wear on opposing enamel compared to ceramic glasses with higher levels of surface roughness [81]. The antagonist's natural teeth gets more aggressive and exhibit a rougher surface as the microstructure of the glass-ceramics is lost, exposing the crystalline phase. It is crucial to note that transparent monolithic zirconia may significantly damage the enamel of adjacent teeth. Nonetheless, this occurs only if metal has undergone sandblasting or glazing, or if the finishing procedure was inadequately executed [82]. Consequently, it is vital to use appropriate cleaning and treatment techniques while using transparent monolithic zirconia to avert any harm to the enamel of opposing teeth [83].

Summary

Due to its outstanding optical and physical properties, ultra-translucent monolithic zirconia (Zr), an orthodontic restoration substance mostly composed of zirconium oxide, is becoming a preferred option for the aesthetic zone. This material's robust mechanical features and capacity to provide exceptional aesthetic results make it an excellent option for indirect attractive veneer repairs. This is achieved via the thorough organization, integration, and implementation of the fundamental concepts and techniques required for Zr-based aesthetic restoration to provide a visually impressive and structurally robust outcome.

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Contemporary ultra-translucent monolithic zirconia restorations provide high strength, require little thickness, and save tooth structure. Before employing resin polishing reagents with these repairs reliably, the bonding surface must be abraded by grit blasting to improve the mechanical connection as well as chemical conditioning. Further study is required to clarify the wear conduct, mechanical efficiency, resilience, stress distribution, and longevity of ultra-translucent monolithic Zr microstructures in conditions that closely replicate oral environments. This approach is aimed to enhance the aesthetic appeal of fine-grain microscopic structures while preserving their intrinsic strength. Published data indicated favorable outcomes and acceptable aesthetics for the implementation of transparent monolithic zirconia veneers. Nonetheless, few clinical reports verifying their survival were identified in the literature. Consequently, extensive clinical trials are essential to validate this therapeutic modality.

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التيجان الزركونية كحل متقدم لتسوس الأسنان لدى الأطفال: مراجعة شاملة للجوانب البيوكيميائية وتقنيات العلاج

الملخص

الخلفية :يُعد تسوس الأسنان لدى الأطفال مشكلة شائعة تتطلب حلولًا ترميمية فعالة. ظهرت التيجان الزركونية كخيار واعد نظرًا لخصائصها الميكانيكية المتفوقة وجمالياتها مقارنةً بالمواد التقليدية. يُعد فهم الجوانب البيوكيميائية وتقنيات العلاج المرتبطة بالتيجان الزركونية أمرًا ضروريًا لتعظيم استخدامها في طب أسنان الأطفال.

الطرق :تحلل هذه المراجعة الشاملة الأدبيات الحديثة حول التيجان الزركونية، مع التركيز على تركيبها، وخصائصها الميكانيكية، ونفاذيتها للضوء، وتقنيات التحضير، وخصائص الالتصاق. تم إجراء بحث منهجي عبر قواعد بيانات مثل PubMed و Scopus وEmbase، مع مراجعة الدراسات المنشورة من عام 2000 إلى 2023 التي تناولت التطورات في مواد الزركونيا وتطبيقاتها السريرية.

النتائج :تُبرز المراجعة أن التيجان الزركونية الأحادية توفر قوة استثنائية، وجماليات عالية، وتوافقًا حيويًا، مما يجعلها مناسبة للأطفال. ساهمت التطورات في تركيبات الزركونيا في تحسين نفاذيتها للضوء وتقليل الحاجة إلى إزالة كبيرة لأنسجة الأسنان. ومع ذلك، لا تزال هناك تحديات في تحقيق قوة ارتباط مثلى نظرًا لانخفاض طاقة السطح للزركونيا. أظهرت معالجات السطح واستخدام الإسمنت اللاصق المحتوي على مونومرات الفوسفات وعدًا كبيرًا في تحسين الالتصاق.

الخلاصة :تمثل التيجان الزركونية تقدمًا كبيرًا في طب الأسنان الترميمي للأطفال، حيث تجمع بين المتانة والجاذبية الجمالية. هناك حاجة مستمرة للبحث لتحسين تقنيات الالتصاق وتحقيق نتائج سريرية أفضل. يتطلب دمج التيجان الزركونية في ممارسات طب أسنان الأطفال فهمًا شاملًا لخصائصها وتنفيذ استراتيجيات علاجية فعالة.

الكلمات المفتاحية :طب أسنان الأطفال، التيجان الزركونية، تسوس الأسنان، تقنيات الالتصاق، مواد ترميمية.