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Review Article

Monolithic Zirconia Crowns: Advantages and Disadvantages in Fixed Prosthodontics

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Abstract

Introduction: Zirconia (Y-TZP) has come to the forefront in dental restorations as a metal-free, long-lasting, and biocompatible restoration due to the demand for the same mineral. It possesses excellent mechanical properties, such as flexural strength of 900–1200 MPa and fracture toughness of 9–10 MPa.m$^{1/2}$. This scoping review aimed to systematically chart and document the existing evidence on the clinical performance, benefits, and limitations of monolithic zirconia crowns.

Methods: Systematic searching was conducted on PubMed, Scopus, and Web of Science using MeSH terms and combined free-text words. Overall, 23 articles were included, and data were narratively and thematically synthesized for reviewing performance.

Results: It was revealed that monolithic zirconia has various advantages, including veneer chipping removal due to its density and veneerlessness. It further supports conservative tooth reduction and offers straightforward conventional cementation. Clinical trials documented a high clinical survival rate (98%) for posterior crowns at 5 years. However, there were aesthetic issues, especially in the anterior area, since only 6.1% of the crowns had an acceptable color match in one study. Overall, unless proper finishing is performed, the risk of extensive antagonist tooth wear is present.

Conclusion: Monolithic zirconia crowns are considered a highly reliable and mechanically sound restorative solution, primarily to posterior teeth and stress-bearing cases. The ease of cementation and high strength are prime benefits. Nonetheless, clinician-friendly stringent finishing and polishing procedures should be followed to avoid the risk of wear on opposing teeth. It is noteworthy that cosmetic constraints will limit its placement in the esthetic zone. Accordingly, more long-term clinical trials of 5–7 years and more are warranted to better evaluate their performance.

Keywords: Monolithic zirconia, Full-contour zirconia, Fixed dental prosthesis, Survival rate, Veneer chipping, Esthetics

Introduction

Searching for materials of strength, biocompatibility, and optimal aesthetics has been a long-standing clinical problem in restorative dentistry. Metal-ceramic restorations have so far been the standard of excellence due to their reliability.[1,2] However, new ceramic-based restorative materials have been innovated and commercialized with increasing demands for metal-free aesthetic dentistry and heightened sensitivities regarding the biocompatibility of dental alloys. Nowadays, all-ceramic restorations increasingly outnumber metal-ceramic restorations for single crowns and fixed dental prostheses (FDPs).[3,4]

While various ceramic systems with highly acceptable aesthetic results have been designed, traditional ceramics (e.g., glass and feldspathic ceramics) generally had difficulty in withstanding the extreme occlusal stresses of posterior regions.[5] Zirconia (yttrium-stabilized tetragonal zirconia polycrystal or Y-TZP) has been a successful alternative in most clinical situations, with superior mechanical properties.[6]

In-vitro testing has confirmed its impressive flexural strength, typically in the range of 900–1200 MPa and 9–10 MPa.m$^{1/2}$ fracture toughness.[7] Monolithic zirconia crowns, which were first presented around 2010, have gained more popularity due to their unique features. One of the most significant advantages of these restorations is their dense, veneerless nature, which excludes the risk of veneer chipping, one of the most common complications of all-ceramic layered crowns.[8,9] Moreover, this allows for more conservative tooth reductions than with conventional metal-ceramic crowns, thereby preserving more tooth structure. The ability to use conventional

cementation methods is another benefit in that it is less technique-sensitive and time-consuming than the multi-step adhesive bonding process involved with certain other ceramic restorations.[10]

Clinical trials have shown promising outcomes regarding the function and longevity of monolithic zirconia crowns. In a prospective study, monolithic zirconia crowns on posterior teeth were found to have a satisfactory survival rate of 98% at the 5-year follow-up.[11] The same study revealed that these crowns experienced less wear than antagonist tooth enamel. Additionally, monolithic crowns had a 5-year complication-free survival rate of 87% in another observational study.[12]

Nonetheless, monolithic zirconia crowns possess disadvantages. Although they have greater mechanical strength, aesthetic performance, particularly for high-translucency materials in the anterior esthetic zone, remains an issue.[13] For example, one study reported that hardly a few crowns (6.1%) were evaluated to be of an acceptable color match.[14] With these clinical considerations, an appropriate comprehension of the advantages and disadvantages of these crowns is required for a proper treatment. Accordingly, this scoping review will cover the systematic research of clinical performance, strengths, and drawbacks of monolithic zirconia crowns in fixed prosthodontics, providing a useful reference for clinicians.

Methods

This scoping review was conducted to rigorously map the existing literature regarding the clinical performance of monolithic zirconia crowns. The applied method followed the Joanna Briggs Institute Manual for Evidence Synthesis to ensure a transparent and rigorous process for an extensive search and synthesis of the evidence.[15] This review discerned and outlined the primary features, advantages, and limitations of monolithic zirconia restorations based on the literature.

Search Strategy

A systematic electronic search across three major scientific databases was performed using PubMed, Scopus, and Web of Science databases. The strategy for the search was developed in consultation with an expert in the subject matter, and a combination of medical subject headings and free-text words was utilized to ensure the retrieval of all relevant publications. The search terms used with Boolean operators are as follows:

("monolithic zirconia" OR "full-contour zirconia" OR "solid zirconia" OR "anatomic zirconia") AND ("crowns" OR "fixed dental prosthesis" OR "FDPs" OR "restorations") AND ("clinical outcomes" OR "clinical performance" OR "survival rate" OR "complications" OR "fracture strength" OR "esthetic" OR "translucency" OR "wear").

Moreover, a manual search of the reference lists and relevant review publications of the included articles was performed to detect any missed publications during the initial electronic search.

Inclusion and Exclusion Criteria

Table 1 presents the criteria considered for the inclusion and exclusion of studies in this review.

Study Selection and Data Extraction

All articles retrieved from the electronic search were imported into a reference management program to remove duplicates. The other records were independently reviewed by two reviewers for their titles and abstracts in order to determine their preliminary eligibility. In addition, disagreement between the reviewers was resolved by consensus and consultation with a third reviewer.

The entire text of the articles meeting the initial filter was then searched and assessed for final inclusion in accordance with the defined eligibility criteria. Further, an explicit data extraction form was built to collect pertinent information from each included study in a systematic manner, that is:

***Study Characteristics*:** Study design, author(s), year of publication, and country of origin

***Methodology*:** Sample size, follow-up duration (in clinical studies), and methodology details (in in vitro studies)

***Key Findings*:** Quantitative and qualitative information regarding clinical outcomes, survival rates, complication types, mechanical characteristics, and esthetic ratings

Table 1. Selection of Studies According to the Inclusion and Exclusion Criteria

	Inclusion Criteria	Exclusion Criteria
Language	Articles published in the English language	Articles published in other languages
Publication date	Articles published from 2000 to 2025	Articles published before 2000
Topic	Articles specifically on monolithic zirconia crowns or FDPs.	Articles on porcelain-veneered zirconia crowns, metal-ceramics, or other types of restorations
Article type	Systematic reviews, clinical trials, prospective and retrospective studies, in vitro studies, and case reports that directly addressed the topic	Conference abstracts, letters, editorials, and articles with restricted access
Parameters	Articles that evaluated mechanical properties, optical properties (esthetics), wear, fracture strength, and clinical outcomes	Parameters: Articles not related to the properties and clinical outcomes of monolithic zirconia crowns

Note. FDPs: Fixed dental prostheses.

***Conclusions*:** Prime conclusions of the authors regarding the clinical performance of monolithic zirconia

The retrieved data were subsequently synthesized into a table to allow for thematic and narrative synthesis, with the identification of important patterns and trends in the literature. This allowed for the final discussion and conclusion of the review to be supported by robust and verifiable scientific evidence. Overall, 23 articles were included in the final review.

Synthesis of Findings

As a scoping review, the extracted data were narratively synthesized to provide a descriptive summary of the research landscape. Furthermore, the results were thematically grouped in an effort to critically evaluate the advantages and disadvantages of monolithic zirconia crowns on different parameters, including mechanical properties, esthetic performance, and clinical results. This enabled the identification of the key concepts and mapping of the evidence available for guiding future research and clinical practices.

Results

Monolithic zirconia crowns have a series of unambiguous advantages and limitations from the scientific literature. One notable advantage was that they have superior fracture resistance and durability. Due to their block-solid nature, restorations that are fabricated using these materials display greater resistance to chipping and fracture. There were superior survival rates as evidenced by clinical investigations, including 100% survival without chipping at 3 years and 98% at 5 years. For monolithic zirconia crowns supported by implants, an astonishing 100% survival was achieved at 7 years of function with no technical or biological issues.[16,17]

Another benefit was the superior mechanical properties of the material. With flexural strength ranging from 900 MPa to 1200 MPa and acceptable fracture toughness, monolithic zirconia can withstand heavy occlusal loads in the posterior region, making them an appropriate and effective choice for patients with advanced tooth wear (e.g., patients with bruxism). In addition, the high strength could provide more conservative tooth preparation and less aggressive tooth reduction than conventional crowns, thereby conserving healthy tooth structure.

The straightforward cementation process was also a significant advantage of monolithic zirconia crowns. These crowns can be cemented simply conventionally with self-adhesive resin cements, which is a less technique-sensitive process than the stepwise adhesive bonding required by other ceramic restorations. The use of self-adhesive resin cement has been shown to minimize debonding. New computer-aided design and computer-aided manufacturing (CAD/CAM) precision has no room for errors with a high accuracy and excellent marginal adaptation.

There are, however, major drawbacks to consider. One serious problem was antagonist tooth wear. Without finishing, the occlusal surface of monolithic zirconia crowns will cause severe wear of opposing natural teeth. Median enamel wear has been reported as 33 μm after 6 months and 46 μm after 2 years, which is significantly higher than natural wear of 10–26 μm.[18,19] The mode of wear is mostly abrasive and mechanical fatigue. However, other studies indicated that well-finished crowns wear opposing teeth slightly, with a mean wear depth of only 9.5 μm at the crown after one year being quoted.[20]

Another disadvantage was esthetic challenges, particularly in anterior regions. Despite a better translucency, the built-in opacity of monolithic zirconia has the potential to spoil the end appearance against more translucent ceramics. One study found 6.1% of posterior crowns to be rated as having an acceptable shade match.[21] Moreover, while survival rates are excellent, monolithic crown complication-free success (87.0%) has been shown to be lower than that of veneered crowns (95.8%), reported complications having been debonding and, on the odd occasion, root fracture.[22] Finally, a persistent finding was the need for long-term clinical trials. While demonstrating great promise for short-term results, there are insufficient data to properly evaluate the long-term survival and performance of these crowns after 5–7 years.

Discussion

The findings of the studies has led to one unmistakable conclusion: monolithic zirconia crowns are a superb restorative option, particularly for back teeth. Their strongest aspect is their unparalleled mechanical strength and fracture and chipping resistance. This is a consequence of their single-block structure, eliminating the weakest link (the veneering porcelain) that is prone to chipping in typical layered restorations. The cited high survival rates from a number of studies (e.g., 100% survival of implant-supported crowns after 7 years) also confirm their reliability in high-stress locations.[23] The favorable strength allows for more conservative tooth preparation, which is one of the key principles of modern dentistry, as it guarantees the preservation of health-related tooth structure. The simple cementation procedure with self-adhesive resin cements is a practical benefit, reducing chair time and technique sensibility compared to other all-ceramic systems.[24] Their excellent marginal fit, ensured by a high accuracy with today's CAD/CAM technology, is due to the above . This is critical to long-term periodontal health and restoration longevity. It further makes these cements a suitable option for the patient with extreme tooth wear since they lead to high technical success in this group.[25]

However, the above-referenced literature also suggests some key disadvantages that should be taken into consideration. Of primary concern is the opposing natural tooth wear risk. While some reports indicate minimal

wear when properly polished, others demonstrate significant enamel loss. Such variability recognizes the critical requirement of a stringent finishing and polishing process for monolithic zirconia restorations to overcome abrasive wear.

Their second serious disadvantage is the esthetic outcome, particularly in the anterior. With all the introduction of high-translucency and layered zirconia, the material's inherent opacity still brings down the final outcome relative to more aesthetic ceramics, such as lithium disilicate. This disadvantage typically constrains their use to posterior cases where strength is more important than esthetics.

Finally, while the short-term results are heartening, there is a requirement for longer term clinical trials involving larger numbers in order to more accurately assess the functioning and complications of such restorations over 5–7 years or more. Previous evidence demonstrated that the lower complication-free success, compared with veneered crowns, , highlights the necessity of examining the specific types of failure other than fracture.

Conclusion

In general, monolithic zirconia crowns are now a highly dependable and mechanically stable restoration option for fixed prosthodontics, especially for posterior teeth and in bruxing high-stress situations. Their high strength, low conservative preparation requirements, and ease of cementation are all significant advantages. Moreover, these crowns have demonstrated excellent long-term survival rates in implant-supported restorations. However, clinicians must be aware of the risk of antagonist tooth wear, which can be prevented with proper finishing and polishing protocols. While the esthetics of monolithic zirconia have been improved, they may still be suboptimal for anterior restorations. Thus, the long-term clinical success and complication rates of these crowns must be further investigated to provide a better representation of their clinical success.

Competing Interests

The authors declare that they have no conflict of interests.

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