



# Editorial: Biofunctional Applications of Zirconia in Dental Devices

Guang Hong<sup>1\*</sup>, James Kit-Hon Tsoi<sup>2</sup> and Jan-Min Han<sup>3</sup>

<sup>1</sup> Division for Globalization Initiative, Graduate School of Dentistry, Tohoku University, Sendai, Japan, <sup>2</sup> Department of Dental Biomaterials, Faculty of Dentistry, The University of Hong Kong, Hong Kong, China, <sup>3</sup> Department of Dental Materials, School of Stomatology, Peking University, Beijing, China

**Keywords:** zirconia, dentistry, biocompatibility, mechanical properties, surface properties

## Editorial on the Research Topic

### Biofunctional Applications of Zirconia in Dental Devices

In dentistry, esthetics is one of the main goals regardless of whether other properties of the material are insufficient. Zirconia, especially Y-TZP, has gained popularity due to its mechanical, esthetic, and outstanding aesthetic performance.

The Research Topic on “*Biofunctional Applications of Zirconia in Dental Devices*” in *Frontiers in Dental Medicine* includes two Reviews and two mini reviews that summarize recent advances on the dental application of zirconia and give research prospect guidance to solve existing problems.

Zirconia is an ideal material for dental and orthopedic application, with its excellent mechanical properties, chemical stability, biocompatibility, and negligible thermal conductivity. In recent years, it has been reported that zirconia implants are a promising alternative to titanium implants, exhibiting similar osseointegration but a superior soft-tissue response in short-term outcomes. The current reviews provide a pertinent summary of the advances in this field of research. Lin et al. review the effects of ZrO<sub>2</sub> on soft tissues. Ectopic epithelial cells have been observed on the surface of ZrO<sub>2</sub>, suggesting that ZrO<sub>2</sub> may be a promising material that can enhance the adhesion of epithelial cells. This review also provides an insight on the application of zirconia as an implant. It can be concluded that: 1. Zirconia is biologically safe when used as an implant material, 2. It has an osteogenic effect when used in bone grafts, 3. It has an affinity to the surrounding soft tissues, 4. New molding technologies have been developed, and 5. Zirconia surfaces can be modified to improve biological activity. Furthermore, the review also weighs the advantages and disadvantages of the use of zirconia in the dental field.

Although zirconia-based bioceramics for dental implants have been used for at least 30 years, some limitations still exist, such as manufacturing difficulties, low temperature degradation (LTD), long-term stability, and clinical experience. Researchers continue to try various ways to solve existing problems, some limited by both lab-based and clinical research. In their mini review, Sun et al. explain the three different crystal structures of zirconia and summarized the currently feasible zirconia modification methods and divided them into three parts, namely physical treatment, chemical treatment, and coatings. At the same time, an intuitive table shows the surface modification methods and lists the effects in enhancing bone formation.

The pursuit of a more esthetic monolithic zirconia without affecting durability has become a driving force for the development of materials in the dental research community. But there is still a query on which laboratory test method is best for revealing and quantifying the useful life of clinical titanium and zirconia. Qu and Liu focused on preclinical and clinical evolutions between titanium and zirconium. In their mini review, they summarize the methods used to test both materials in

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### Edited and reviewed by:

Josette Camilleri,  
University of Birmingham,  
United Kingdom

### \*Correspondence:

Guang Hong  
hong.guang.d6@tohoku.ac.jp

### Specialty section:

This article was submitted to  
Dental Materials,  
a section of the journal  
*Frontiers in Dental Medicine*

**Received:** 21 December 2021

**Accepted:** 05 January 2022

**Published:** 18 February 2022

### Citation:

Hong G, Tsoi JK-H and Han J-M  
(2022) Editorial: Biofunctional  
Applications of Zirconia in Dental  
Devices. *Front. Dent. Med.* 3:841120.  
doi: 10.3389/fdmed.2022.841120

both laboratory and clinical studies and highlight the inability to provide adequate proof on the comparability of the two materials due to lack of long-term follow ups.

Artificial Intelligence (AI) is attracting considerable interest and is rapidly developing because of computer technology. Based on data analyses and prospective evaluation, AI techniques enhance zirconia-related research. Luo et al. in their review display a clear vision in AI in dental and zirconia-related research, including clinical usage and laboratory-based studies. With the use of AI, color matching, customizing abutments, and improvement in cementation techniques can be addressed. This reduces the errors of manufacture and thus the cost of prosthodontic therapy. The review also introduced some interesting concepts, such as AI appointments, medical guidance, oral disease diagnosis, and oral monitoring, which related to many hot clinical topics. And a special clinical research on gum inflammation diagnosing which used Deeplabv3+ network with Xception and mobilNetV2 was listed, greatly confirming the feasibility of AI in the future. Through this review, we can see the evolution of AI in the development of novel approaches for the biomedical applications of zirconia in dental devices and get a clear understanding of AI technology.

In conclusion, with this Research Topic we have received a series of reviews describing the progress made in the biofunctional applications of zirconia. These reviews greatly contribute to giving a further understanding of new dental materials, as well as an outstanding viewpoint of potential usage in dental devices.

## AUTHOR CONTRIBUTIONS

GH drafted and further revised the manuscript. JT and J-MH critically reviewed the manuscript and significantly improved it. All authors listed have read this editorial and approved it for publication.

## ACKNOWLEDGMENTS

As Research Topic editors we would like to express our sincere thanks to all authors and references for their valuable contributions, which made it possible for us to complete this interesting Research Topic on Biofunctional Applications of Zirconia in Dental Devices.

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