

“ Popularization perspective of biomimetics approaches in restorative dentistry.”

## Popularization perspective of biomimetics approaches in restorative dentistry

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### Abstract

*Biomimetics approaches in restorative dentistry are a concept that uses nature as a mentor in coronal dental restoration by using appropriate crown restoration materials. The overall aim of this study is to describe the importance of biomimetic practice in restorative dentistry.*

*This is a literature review study carried out on article published on Pubmed, Google Scholar and Science Direct, during the years 2014 to 2024, in French or English language with an impact factor. Among the 82 articles collected, 52 discussed biomimetic techniques in restorative dentistry. This research highlighted different techniques and effective protocols for achieving biomimetic restoration, as well as the concept of tissue economy and the choice of materials to be used.*

*The pretherapeutic, therapeutic, and final finishing steps chosen by practitioners were identified. The longevity of aesthetic results using material composites was demonstrated. This study shows the importance of biomimetic approaches so that the techniques can be popularized by practitioners.*

**Keywords :** adhesive dentistry, biomimetic materials, technic, biomimicry, bioemulation.

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**I-Introduction**

The word “biomimicry” is a neologism coined by Otto HS, an American academic and inventor. It describes the notion of transferring biology to technology. Derived from two Greek roots, *bios* (life) and *mimesis* (imitation), this neologism refers to the age-old approach of the human species. It consists of observing nature and drawing inspiration from it to innovate, improve its condition, and its productions [1]. In the field of odontostomatology, restoring dental hard substance loss, whether of bacterial, non-bacterial or traumatic origin, requires ethical consideration [2]. Adhesive dentistry allows for coronal dental restorations to be performed with respect for the therapeutic gradient, meaning they are becoming less and less invasive. This concept is part of an obvious tissue-sparing technique, or “biomimetic” approach, which enables the conservation of as much healthy hard tissue as possible. The evolution of these concepts, combined with advances in biomaterial engineering, is now giving a new impetus to adhesive and aesthetic dentistry, with considerable restoration durability [3]. This new concept seeks to prioritize composite restorations in order to restore the natural biological, mechanical, functional and esthetic appearance of the newly restored tooth [4]. How can biomimetic dentistry be applied to coronal restorations, according to the literature ? The overall aim of this research was to identify the techniques and materials needed to achieve biomimetic restorations.

**II- Methodology**

This is a literature review study conducted using articles published on PubMed, Google Scholar, and Science Direct from 2014 to 2024. The research was carried out within the computer space of the Tropical Institute of Odonto-Stomatology in Mahajanga, Madagascar. Keywords : “adhesive dentistry,” “biomimetic materials,” “technic,” “biomimicry,” and “bioemulation” are used with the Boolean operators “AND” searches. Research were carried out via more database : PubMed, a database of open-access scientific articles managed by the NIH (National Institute of Health) in the USA, Google Scholar, an academic search engine that indexes academic articles, books, and technical reports from various academic sources, SCASPACE, EM Consult, Science Direct, an online platform offering a wide range of scientific articles, including specialist journals in dentistry, Medline, and Cochranec. All scientific articles dealing with biomimicry and bioemulation in adhesive dentistry were included in the search if they met scientific standards, had an impact factor, and were published and written in French or English language during the study period. The exhaustive sampling method was chosen. Of the 1,701 articles consulted, a total of 82 scientific articles were selected, 52 of which addressed the specificity of biomimetic coronal restoration technic. Articles published during the study period that did not meet the variable evaluation criteria were excluded from this search. The variables studied focused on general information of the articles consulted (continent of publication, year of

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publication, language of writing, type of article, number of authors, topics evoked), the concept of evolution of biomimetic adhesive restorative materials, and the therapeutic steps evoked by the authors. The data obtained were analyzed using SPSS version 20.0 software.

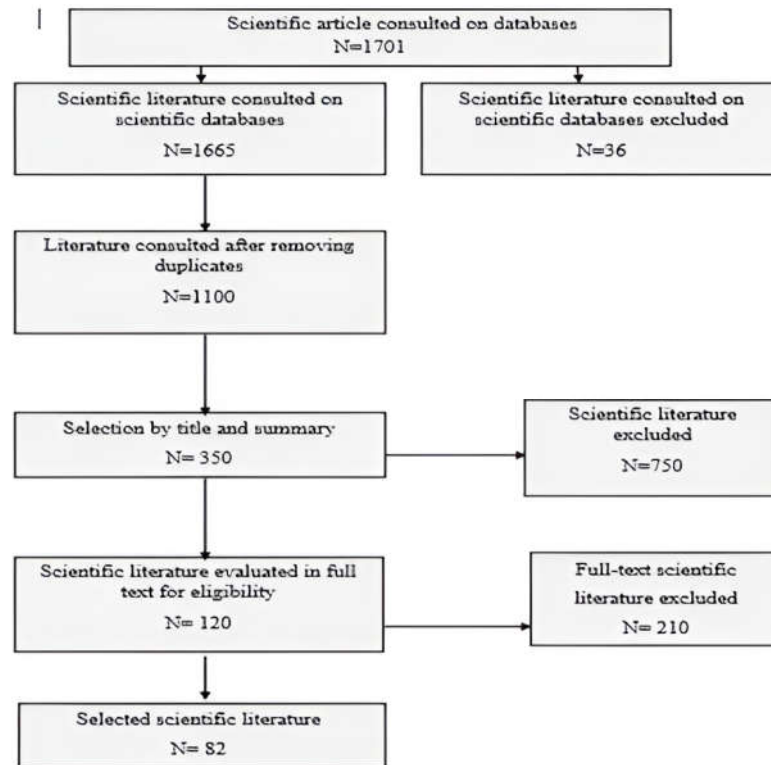


Figure 1 : Flowchart of scientific article selection

**III-Results**

This research was conducted to identify the importance of the practice of biomimicry technic in adhesive dentistry. The overall aim of this research was to identify the technic and materials needed to achieve biomimetic restorations.

• **General Information on the Articles reviewed**

According to the country of publication, 43.90% of the articles were published in America, 28.10% in Europe, 21.91% in Asia, and 6.09% in Africa [Table I]. As stated by the year of publication, 40.24% of the articles were published between 2021 and 2024, 32.92% were published from 2014 to 2017, and 26.84% were published between 2018 and 2020 [Table II]. According to the topics discussed, among the 82 scientific articles reviewed, 63.41% focused on biomimetic restoration techniques in adhesive

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dentistry, while 28.05% discussed general topics, and 8.54% covered historical aspects of biomimicry in dentistry [Table III].

**Table I : Distribution of scientific articles reviewed by continents**

<b>Continents</b>	<b>n N=82</b>	<b>%</b>
America	36	<b>43,90</b>
Europe	23	28,10
Asia	18	21,91
Africa	5	06,09
<b>Total</b>	<b>82</b>	<b>100</b>

**Table II : Distribution of scientific articles reviewed by year of publication**

<b>Year of publication</b>	<b>n N=82</b>	<b>%</b>
2014 to 2017	27	32,92
201 to 2020	22	26,84
2021 to 2024	33	<b>40,24</b>
<b>Total</b>	<b>82</b>	<b>100</b>

**Table III : Distribution of scientific articles reviewed by topics**

<b>Topics</b>	<b>n N=82</b>	<b>%</b>
Biomimetism in general	23	28,05
History	7	08,54
Biomimetics approaches	52	<b>63,41</b>
<b>Total</b>	<b>82</b>	<b>100</b>

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• **Concept of restoration materials evolution**

Regarding the evolution of restoration materials, 48.07% of the authors highlighted the evolution of dental composite materials, and 17.30% mentioned the evolution of dental adhesives. The concept of tissue economy was discussed by 21.15% of the authors [Table IV].

**Table IV : Distribution of scientific articles reviewed by concept of evolution in dental restoration**

<b>Concept of evolution</b>	<b>n N=52</b>	<b>%</b>
Tissue economy concept	11	21.15
Aesthetic concept	5	09.63
Evolution of dental adhesives	9	17.30
Evolution of dental composites	25	<b>48.07</b>
Evolution of the biological concept	2	03.85
<b>Total</b>	<b>52</b>	<b>100</b>

• **Therapeutisc steps emphasized**

Before biomimetic restoration, the importance of dental isolation was emphasized by 78.85% of the authors [Table V]. To mimic the natural appearance of the tooth being restored, 92.31% of the authors stressed the importance of chromatic analysis, which is useful for choosing the appropriate composite shades [Table V]. A proportion of 96.15% of the authors preferred the composite modeling step during the finishing of the restoration and considered it crucial for achieving a biomimetic effect in the restoration [Table V].

**Table V : Distribution of scientific articles reviewed by therapeutic steps emphasized**

<b>Therapeutic steps emphasized</b>	<b>n N=52</b>	<b>%</b>
<b>Dental isolation</b>		
Yes	41	<b>78.85</b>
No	11	21.15
<b>Total</b>	<b>52</b>	<b>100</b>
<b>Chromatic analys</b>		
Yes	48	<b>92.31</b>
No	4	7.69
<b>Total</b>	<b>52</b>	<b>100</b>
<b>Modeling and sculpture</b>		
Yes	50	<b>96.15</b>
No	2	3.85
<b>Total</b>	<b>52</b>	<b>100</b>

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- **Aesthetic longevity of the restoration**

The initial quality of composite restoration influences immediate and long-term success. The practitioner's expertise in implementing the procedures is therefore very important, and the use of microhybrid or nanohybrid composites is the standard. 51.92% of the authors reported an aesthetic longevity of results ranging from 5 to 10 years [Table VI].

**Table VI : Distribution of scientific articles reviewed by Aesthetic Longevity of the restoration**

Aesthetic longevity of the restoration	n N=52	%
Under 5 years	14	26.92
5 years to 10 years	27	51.92
Over 10 years	11	21.16
<b>Total</b>	<b>52</b>	<b>100</b>

#### IV- Discussion

- **Popularization of the biomimetic restorative technique**

The scarcity of research on biomimetics in dentistry in Africa (6.06%) was noted according to the research results [Table I]. The majority of articles consulted were published between 2021 and 2024, with a proportion of 40.24% [table II]. These demonstrate that the concept of biomimicry represents a new concept of interest to contemporary odontostomatological researchers.

- **Restorative concept highlighted**

According to the characteristics of the materials used for the restoration, a proportion of 48.07% of authors mentioned the incessant evolution of dental composites [Table IV]. According to Kano P in 2023, biocompatibility and aesthetic concepts exploring in dental aesthetics will be achieved by examining the role of biomaterials [5].

- **Biomimetic restoration steps highlighted**

Before restoration, the importance of tooth isolating has been highlighted by authors. Sarwar R, in 2024, confirmed the usefulness of the dental dam in both restorative dentistry and endodontics [6]. Kharouf N et al. in 2024, propose combining the basic isolation principle with the use of a light-curing liquid dam to improve field sealing performance [7]. In order to imitate the natural appearance of the tooth, the majority of authors (92.31%) emphasized the usefulness of chromatic analysis. This step will be done when selecting the type of composite. The principle of composite shade selection outlined by Vanini L and Mangani F in 2001 was modernized by Francisco C.-P, in

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2021. In his review, he proposes the use of Artificial Intelligence (AI) and Machine learning (ML), which have wide applications in treatment planning and cosmetic dentistry procedures [8], [9]. When finishing the restoration, according to Paolone G., Scolavino S., Gherlone in 2017, composite modeling enables modeling as well as easy and best for natural finishing of the restoration; it is manipulated with a brush before light-curing. Composite sculpting enables the overall shape, macro-anatomy and micro-anatomy of the restoration to be realized [10]. A proportion of 96.15% of authors followed this step and considered it crucial for achieving a biomimetic effect of the restoration [Table V].

- **Aesthetic success of the restoration**

According to Heintz S. et Al, 2015, the average lifespan of a dental composite has been estimated to 7 and 10 years [12]. A proportion of 51.92% of authors reported a durability of aesthetic results of 5 to 10 years [Table VI].

## **Conclusion**

The general objective of this research was to identify the technique and materials necessary for a biomimetic restoration. The concept of biomimicry is based on fundamental principles that have become the ambassadors of modern and contemporary dentistry. It related to tissue economy, adhesion, the biomechanical behavior of substitutes, and aesthetics. The natural tooth obviously remains the reference model. It procure substituents tend to mimic as closely as possible the unique characteristics conferred by enamel, and dentin. This study found that the popularization of the biomimetic restorative technique on the African continent needs to be boosted. The most popular therapeutic concept is based on the continuous evolution of composite materials. This alarms practitioners to exploit effective restorative techniques specific to each variety of composite. The therapeutic restorative steps highlighted by the authors were the isolation of the tooth to be restored, the usefulness of chromatic analysis prior to the actual restoration, and, finally, the importance of the finishing stage of the restoration. The durability of the aesthetic result mentioned by the authors is 5 to 10 years.

## **Acknowledgement**

None

## **Conflict of interest**

No conflict of interest

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