MEDICINE AND MATERIALS
Volume 5, Issue 1, 2025: 17-22 | ISSN: 2784 – 1499 & e-ISSN: 2784 – 1537
DOI: 10.36868/MEDMATER.2025.05.01.017 | www.medicineandmaterials.com |

PROPERTIES AND PERFORMANCE OF GOLD IN DENTAL PROSTHETICS

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Abstract

Gold is one of the most appreciated materials used in dental prosthetics due to its outstanding properties, such as corrosion resistance, malleability, ductility and biocompatibility. This review looks at the role of gold in dentistry, highlighting its advantages and limitations compared to other materials. The physical and chemical properties of gold, such as chemical stability and malleability, allow for precise and durable dental restorations. Mechanical properties, such as wear resistance and controlled flexibility, contribute to the reliability of restorations, ensuring optimal performance in the oral environment. The biocompatibility of gold is a crucial aspect, as it is chemically inert and well tolerated by oral tissues, reducing the risk of allergic or inflammatory reactions. However, its high costs and limited aesthetics in visible areas can pose barriers to its widespread use. Gold remains a reference material in modern dentistry, being ideal for restorations in the posterior areas or for cases where durability and reliability are priorities. The future of research could explore advanced alloys and digital technologies to optimize the use of this noble material in dental prosthetics.

Keywords*:* Gold, dental prosthetics, biocompatibility, durability, malleability, corrosion.

Introduction

Gold, one of the oldest metals used by mankind, has a long history in medicine and dentistry. Since ancient times, it has been used to make dental jewelry and functional restorations due to its remarkable properties, such as corrosion resistance and malleability. In modern dentistry, gold has remained a reference material in dental prosthetics, being used to make crowns, bridges and other types of restorations due to its exceptional performance. In the context of the diversification of dental materials, the detailed analysis of gold remains relevant for understanding its advantages compared to contemporary options, such as ceramics, metal alloys or composite materials [1-3].

The importance of quality materials in dental prosthetics cannot be underestimated, as they influence both the clinical success of the treatment and the patient's comfort and satisfaction. The materials used must meet stringent requirements, including biocompatibility, durability, dimensional stability, and the ability to resist masticatory forces. Gold excels in many of these aspects, being considered a gold standard in the evaluation of other materials. [1-4].

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The purpose of this review is to analyze the physical, chemical and mechanical properties of gold, along with its clinical performance in dental prosthetics. This analysis will highlight why gold continues to be a top choice despite high costs and competition with modern materials. We will also address the implications of its biocompatibility in reducing allergic reactions and inflammation in the oral environment, as well as its durability in the face of wear and tear and other degradation factors. In addition, this review will examine current trends in research and development, including gold alloys and the integration of digital technologies, such as CAD/CAM systems, to optimize the manufacturing process of dental restorations. We will also discuss the aesthetic impact of gold, which, although perceived by some patients as inferior to aesthetic materials, still offers considerable practical advantages in the posterior areas, where functionality prevails.

In addition to its clinical value, gold also has economic significance. As one of the most expensive dental materials, its use involves a higher cost for both patients and practitioners. However, the investment is justified by the long lifespan of the restorations and the reduction of the risks associated with material failures. Thus, gold remains a strategic choice in clinical situations where long-term reliability is a priority [2-7].

Gold occupies a central place in dental prosthetics due to its unique combination of physical, chemical, and mechanical properties, along with its outstanding clinical performance. This review aims to contribute to a deeper understanding of this noble material and its role in modern dentistry while opening up new perspectives for future research [1,3-7].

Physical, chemical, and mechanical properties of gold in dental prosthetics

Gold, a noble metal widely used in dental prosthetics (Fig. 1), exhibits a remarkable combination of physical, chemical, and mechanical properties, making it an ideal material for various types of restorations. Among its main advantages are its exceptional corrosion resistance, malleability, and ductility, as well as high mechanical durability, all of which contribute to its superior clinical performance [5-8].

Fig. 1. Presentation of the fixed gold prosthetic work after 20 years from the definitive cementation: A) frontal norm presentation, B) occlusal situation presentation.

Physical and chemical properties

One of the most important advantages of gold is its resistance to corrosion and oxidation. In the oral environment, where high humidity and pH fluctuations can degrade other materials, gold remains stable, preventing the release of ions that could cause adverse reactions. This chemical stability is a key factor in its long-term use in dental restorations [5-10].

The malleability of gold allows it to be precisely shaped to achieve an excellent adaptation to dental structures, reducing the spaces that could favor the accumulation of plaque. Its ductility offers the possibility of creating extremely fine and tailored edges, which is essential for achieving a quality marginal seal. In addition, gold has moderate thermal conductivity, which helps protect the dental pulp from extreme temperature variations [3,6-11].

Mechanical properties

Mechanically, gold is hard enough to withstand the wear and tear caused by mastication, but it also has a controlled elasticity, making it ideal for absorbing masticatory shocks. This unique combination of hardness and flexibility reduces the risk of fracture, both of the restoration and of the adjacent natural teeth. Gold also has outstanding resistance to permanent deformation, which helps maintain the structural integrity of the restoration over time [6,11-14].

Another important aspect of gold is its compatibility with other materials used in dentistry. Gold alloys, which include small amounts of copper, silver, or platinum, improve mechanical properties such as tensile strength and hardness without compromising biocompatibility. These alloys are frequently used for complex restorations, such as dental bridges, which require superior strength [12-15].

In the oral environment, gold offers exceptional stability and durability that often surpasses other materials, such as ceramics or composites. This makes it ideal for use in the posterior areas of the oral cavity, where masticatory forces are greater. In addition, gold's malleability allows for rapid and precise clinical adjustments, contributing to patient comfort [14-18].

The biocompatibility of gold is one of the defining characteristics that makes it an ideal material for use in dental prosthetics. As a noble metal, gold is chemically inert, which means that it does not react with oral fluids or tissues in the oral cavity. This chemical stability contributes significantly to its acceptance by the body and to the reduction of the risk of side effects [12,15-19].

Gold is well tolerated by oral tissues, and restorations made from this material pose minimal risk of inflammation or irritation of the gums. Compared to other metal materials used in dentistry, such as nickel or cobalt-based alloys, gold does not cause allergic reactions. This is crucial, especially for patients with known sensitivities or allergies to other metals. In addition, gold does not promote plaque buildup, which helps maintain long-term gum health [15-20].

In the oral environment, gold maintains its physical and chemical properties without suffering degradation. Unlike other materials, which can release ions or oxidize, gold remains stable and does not interfere with the biological balance of the oral cavity. This characteristic makes it particularly suitable for use in permanent restorations, where longevity and safety are essential [4,16-22].

Conclusions

Gold remains a benchmark material in dental prosthetics due to its unique combination of physical, chemical and mechanical properties, along with exceptional biocompatibility. Its chemical stability ensures resistance to corrosion and oxidation, making it ideal for use in the oral environment, characterized by humidity and pH fluctuations. The malleability and ductility of gold allow for precise edge restorations, reducing the risk of bacterial infiltration and associated complications.

The physical, chemical and mechanical properties of gold position it as a material of excellence in dental prosthetics. Its wear resistance, chemical stability, and adaptability to dental structures make it a preferred choice for durable and effective restorations. Despite the high costs, gold continues to be a gold standard due to its unique combination of reliability and clinical performance.

Although gold's biocompatibility is remarkable, the high costs may limit its widespread use. In addition, some patients may find that the aesthetics of gold do not meet their expectations, especially in the visible areas of the oral cavity. However, for back areas, where aesthetics are less important, gold remains an excellent choice due to its durability and safety.

Gold's biocompatibility, combined with its chemical stability and uneventful integration into the oral environment, makes it an ideal material for dental prosthetics. By reducing the risk of allergies and inflammation, gold ensures patient comfort and safety, cementing its position as a premium material in modern dentistry.

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Received: December 11, 2024
Accepted: February 25, 2025