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Gold in Dental Medicine

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Abstract

Gold has been used in dental medicine for thousands of years due to its unique physicochemical properties. Despite the rise of aesthetic materials, gold remains the “gold standard” for durability and biocompatibility in many dental restorations. Gold in dentistry is not just an ‘expensive’ material, but part of the cultural and medical history of mankind. It is a reliable and biocompatible material in restorative dentistry. Despite the competition from modern materials, due to its unique properties, its role in specific clinical indications remains significant. While not as common as in the past, dentists still use gold, often in combination with other metals, for dental work like crowns and fillings, particularly in back molars where durability is crucial. Gold's strength, resistance to corrosion, and biocompatibility make it a reliable choice, though its metallic appearance is less aesthetically appealing than tooth-colored options.
We believe that future research can revive the application of this metal in dentistry.

Keywords: Gold, dental medicine, biocompatibility

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Introduction

Gold is a chemical element with atomic number 79. In its pure form, it is a bright, slightly orange-yellow, dense, soft, malleable metal. Chemically, gold is a transition metal, and one of the noble metals. It is one of the least reactive chemical elements. It is usually found in nature as a metallic element or as salts (1). As a relatively rare element, gold is a precious metal that has been used for minting, jewelry, and other works of art throughout the recorded history. In the past, a gold standard was often implemented as a monetary policy (2).

Aim

This review outlines the historical background, properties, clinical applications, advantages, disadvantages, and modern perspectives of gold in dentistry.

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Results

GENERAL MEDICINE

Today we use gold compounds as pharmaceuticals in medicine due to their anti-inflammatory properties. These drugs reduce the pain and swelling. They were used against tuberculosis and parasites (3-4). In the past gold was used as an anxiolytic, in the treatment of nervous disorders - depression, epilepsy, migraine, glandular problems, impotence, alcoholism, anticancer agent (5).
Colloidal gold is used in research applications in medicine, biology and materials science. It has the ability to adsorb protein molecules onto its surface. Colloidal gold particles coated with specific antibodies can be used as probes for the presence and position of antigens on the surface of cells (6). In ultrathin sections of tissues viewed by electron microscopy, the immunogold labels appear as extremely dense round spots at the position of the antigen (7).
Gold implants are used in various medical procedures, including reconstructive surgery of the middle ear, upper lid closure in facial nerve paresis-induced lagophthalmos, drug delivery microchips, treatment of rheumatoid arthritis, use on the surface of voice prostheses, and endovascular stents (8).
An isotope gold is used in nuclear medicine, in some cancer treatments and for treating different diseases (9-10). Gold is used as signal source in the scanning electron microscope (6).

DENTAL MEDICINE

Gold is one of the oldest materials used in dentistry, with archaeological evidence dating back over 3000 years. In a burial shaft at Giza, in 1914 Junker found two molar teeth held together by a gold wire (11).
Early finds of gold used in dentistry come from the Etruscans (c. 700 BC), who inhabited Italy near Bologna. Archaeological excavations revealed gold bands that were used to bind and stabilize teeth (2). Whole 'bridges' made of gold have been discovered, indicating an extremely advanced level of healthcare (12).
Gold dentures, gold crowns, and gold rings have been found in tombs and sarcophagi from ancient Egypt. Gold was a symbol of divine power, bringing health and eternity, and was used for dental treatment (13). Gold threads have been found in some mummies to strengthen shaken teeth or hold decorative inlays (14).
There is evidence for the use of gold for ornamental purposes in the oral cavity in Phoenician aristocrats around 600-400 BC (15).
The Romans used gold bands and even gold crowns (caps) to strengthen teeth. They bound teeth with gold threads and made gold dentures (16).
The Sveshtar tomb near Sboryanovo in Bulgaria dates back to the 3rd century BC. A tooth wrapped in a gold crown was discovered there. It suggests that the Thracians and Getae had developed views on healing, dental knowledge and practices. The find comes from a pit, in which, along with cremated bones, elements of women's gold jewelry were also found (17).
During the Middle Ages, gold was used less frequently in dentistry, mainly due to limited access and technological difficulties.

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The first printed book on dentistry by Michael Blum in 1530 in Leipzig (The Little Pharmacopaeia) provides advice on treating tooth decay, recommending filling it with a gold leaf (18).
In 1728, Pierre Fauchard described the use of gold bands and wires to hold artificial teeth in his book Le Chirurgien Dentiste (20).
Aroud 1800s, dentists started to use gold as material for filling teeth (20). During the 17th-19th centuries, gold restorations became more common and precise. Gold casting and forging methods developed, making it possible to fabricate crowns and partial dentures with better adaptation.
In the early 20th century, gold became the dominant material for crowns, bridges, inlays and onlays. Gold alloys with copper, platinum and palladium were introduced to increase strength and control hardness (21). In the mid-20th century, gold structures were favored in the United States and Europe, especially in the distal region, because of excellent wear resistance and minimal damage to antagonists.
From the late 20th century onwards, ceramics and zirconia began to replace gold due to the aesthetic requirements of patients.

PROPERTIES

Its excellent corrosion resistance, biocompatibility, and mechanical properties have made it a preferred choice for indirect restorations, posts, and crowns. Gold is suitable for dentistry because it is malleable, and closely mimics the hardness of natural teeth, causing minimal abrasion to antagonist teeth (22). Gold was used before silver became available and has continued to be used for specialized purposes (18).
Pure gold (24K) is too soft for clinical use; therefore, dental alloys usually contain 60–80% gold combined with metals such as copper, silver, palladium, or platinum. These alloys retain excellent corrosion resistance and mechanical strength in restorative dentistry, especially for tooth restorations, such as crowns and permanent bridges (23).
It has good biocompatibility, minimal cytotoxicity and rare allergic reactions. This makes gold an excellent choice for patients with metal sensitivities (23). Gold alloys resist tarnish and degradation in the oral environment so they have excellent corrosion resistance.
Among the advantages of gold are high precision and marginal adaptation, its ability to reduce recurrent decay and ensure marginal integrity (24), its outstanding biocompatibility and minimal gingival irritation (23), and its durability with clinical lifespans exceeding 40 years in some cases (24).
On the other hand it is costly, has poor esthetics (which limits its use in anterior restorations) and has a potential for galvanic reactions when in contact with other metals (although quite rare) (23).
Evaluating the longevity of indirect adhesively-luted ceramics compared to conventionally cemented gold single tooth restorations, Tennert C et al. found lower annual failure rates for metal restorations ranging from 0% to 2.1% (25).

CLINICAL APPLICATIONS

- Gold alloys are primarily used in indirect restorations such as inlays, onlays, crowns, bridges, fixed dental prostheses, and periodontal splints. Their superior marginal fit reduces

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microleakage and secondary caries risk (26). Gold alloys have sufficient strength and corrosion resistance, and they are relatively biocompatible. In addition, gold dental prostheses have a long life cycle. Esthetic concerns and cost make it less desirable today than in the past(8).

- Clasps and other elements of dentures.
- Posts and Cores fabrication offer excellent retention and biocompatibility when restoring endodontically treated teeth (26).
- Gold has been used as a component in implant materials (27). Clinical reports have documented that the surfaces of gold implants have been modified or encased in biocompatible alloplastic materials, or they have been replaced by cheaper and more biocompatible materials (8).
- In the early days of fixed-appliance orthodontic treatment, brackets were welded to gold or stainless steel bands. Gold was used for bands and wires due to corrosion resistance. Its high cost limits current orthodontic use (28).
- When comparing the vertical marginal gap of cast and milled full coverage gold copings, results indicate that gold restorations provide a vertical marginal gap that is an acceptable alternative to traditional gold crown casting techniques (29).
- Bonding is a major component of the therapeutic arsenal. We routinely bond attachments to enamel as well as to other surfaces including dentin, ceramics, acrylics, steel, amalgam, and gold, especially for adult patients. This procedure poses certain technical problems for which adapted and specific technical protocols can provide solutions (30).

PERSPECTIVES

Although ceramics and zirconia-based restorations are gaining popularity for esthetics, gold alloys remain invaluable in posterior restorations where strength and longevity are paramount, especially in patients with parafunctional habits (31).

Henry DB in 2022 presents a new idea for increasing the life expectancy of class II composite restorations where the proximal marginal seal is compromised by the necessity to rely on dentin bonding. Studies show that bonding to dentin in areas with high levels of bacterial action, combined with sustained high plaque formation, tends to be the weakest point with regard to sustained long-term restorations. The author presents a thought experiment, combined with clinical evidences, for combining gold foil with composite in these areas for the class two composite restoration. The results will be to develop a procedure utilizing the properties of gold foil that make it one of the longest-lasting restorative materials for a truly long-lasting and healthy class II restoration (32).

Gold nanoparticles have gained significant attention in the biomedical field owing to their versatile properties. Nanoparticles can be customized by modifying their size, shape and surface characteristics. In recent years, extensive research has explored the integration of gold nanoparticles into various dental materials, including titanium, polymethylmethacrylate and resin composites (33). Incorporation of gold nanoparticles into heat-polymerised polymethylmethacrylate resin led to decrease of the flexural strength and elastic modulus. At the same time, the density, thermal conductivity and hardness increased (34).

3D Printing of gold alloys may allow for cost-effective gold printing, reducing waste and improving access.

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Conclusion

Gold in dentistry is not just an 'expensive' material, but part of the cultural and medical history of mankind. It is a reliable and biocompatible material in restorative dentistry. Despite the competition from modern materials, due to its unique properties its role in specific clinical indications remains significant.

While not as common as in the past, dentists still use gold, often in combination with other metals, for dental work like crowns and fillings, particularly in back molars where durability is crucial. Gold's strength, resistance to corrosion, and biocompatibility make it a reliable choice, though its metallic appearance is less esthetically appealing than tooth-colored options.

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References

1. "The reactivity series of metals - Reactions of metals - AQA - GCSE Combined Science Revision - AQA Trilogy". BBC Bitesize. Retrieved 2 July 2025.
2. Duckenfield, Mark (2016). The Monetary History of Gold: A Documentary History, 1660–1999. Routledge. p. 4. ISBN 978-1-315-47612-4. "Its scarcity makes it a useful store of value; however, its relative rarity reduced its utility as a currency, especially for transactions in small denominations."
3. Messori, L.; Marcon, G. (2004). "Gold Complexes in the treatment of Rheumatoid Arthritis". In Sigel, Astrid (ed.). Metal ions and their complexes in medication. CRC Press. pp. 280–301. ISBN 978-0-8247-5351-1.
4. Kean WF, Kean IR (June 2008). "Clinical pharmacology of gold". Inflammopharmacology. 16 (3): 112–25. doi:10.1007/s10787-007-0021-x. PMID 18523733. S2CID 808858.
5. Richards, Douglas G.; McMillin, David L.; Mein, Eric A. & Nelson, Carl D. (January 2002). "Gold and its relationship to neurological/glandular conditions". The International Journal of Neuroscience. 112 (1): 31–53. doi:10.1080/00207450212018. PMID 12152404. S2CID 41188687.
6. Faulk, W. P.; Taylor, G. M. (1971). "An immunocolloid method for the electron microscope". Immunochemistry. 8 (11): 1081–3. doi:10.1016/0019-2791(71)90496-4. PMID 4110101.
7. Roth, J.; Bendayan, M.; Orci, L. (1980). "FITC-protein A-gold complex for light and electron microscopic immunocytochemistry". Journal of Histochemistry and Cytochemistry. 28 (1): 55–7. doi:10.1177/28.1.6153194. PMID 6153194.
8. Demann ET, Stein PS, Haubenreich JE. Gold as an implant in medicine and dentistry. J Long Term Eff Med Implants. 2005;15(6):687-698. doi:10.1615/jlongtermeffmedimplants.v15.i6.100
9. "Nanoscience and Nanotechnology in Nanomedicine: Hybrid Nanoparticles In Imaging and Therapy of Prostate Cancer". Radiopharmaceutical Sciences Institute, University of Missouri-Columbia. Archived from the original on 14 March 2009.

DOI: 10.18044/MEDINFORM.2025123.2152 ISSUE 3, 2025

10. Hainfeld, James F.; Dilmanian, F. Avraham; Slatkin, Daniel N.; Smilowitz, Henry M. (2008). "Radiotherapy enhancement with gold nanoparticles". Journal of Pharmacy and Pharmacology. 60 (8): 977–85. doi:10.1211/jpp.60.8.0005. PMID 18644191. S2CID 32861131.
11. Donaldson J. A., The Use of Gold in Dentistry AN HISTORICAL OVERVIEW. PART I; British Dental Association Museum, London, U.K.1980. 117-124.
12. Ring ME. Dentistry: An Illustrated History. New York: Abrams; 1985.
13. Scully C. Oral and Maxillofacial Medicine: The Basis of Diagnosis and Treatment. 3rd ed. Edinburgh: Elsevier; 2013.
14. Forshaw RJ. Dental health and disease in ancient Egypt. Br Dent J. 2009;206(8):421–424. doi:10.1038/sj.bdj.2009.300
15. Alt KW, Türp JC, Knipper C. History of dentistry: A review of its development from ancient to modern times. J Investig Clin Dent. 2012;3(1):1-6. doi:10.1111/j.2041-1626.2011.00093.x
16. Anusavice KJ. Phillips' Science of Dental Materials. 11th ed. Philadelphia: Saunders; 2003.
17. Panov Vl, Todorova E, HISTORICAL DEVELOPMENT OF DENTAL CARE IN BULGARIA, Varna Medical Forum, 2022, 11(1), 155-159 (in Bulgarian)
18. Donaldson, J. A. (1980). "The use of gold in dentistry: An historical overview. Part I". Gold Bulletin. 13 (3): 117–124. doi:10.1007/BF03216551. ISSN 0017-1557. PMID 11614516.
19. Jean Claude de Vaux. "Who is Pierre Fauchard?". Pierre Fauchard Academy. Retrieved June 3, 2024.
20. "7 Golden Facts About Gold Teeth and Grills | Explorer". 14 April 2017. Retrieved August 1, 2021.
21. McCabe JF, Walls AWG. Applied Dental Materials. 9th ed. Oxford: Wiley-Blackwell; 2013.
22. "13,000-Year-Old Fillings Prove Ancient Dentistry Was Brutal - D-brief". Archived from the original on 2019-09-04. Retrieved 2019-04-23.
23. Wataha JC. Biocompatibility of dental casting alloys: a review. J Prosthet Dent. 2000;83(2):223-234. doi:10.1016/S0022-3913(00)70091-1
24. Christensen GJ. Longevity of dental restorations. J Esthet Restor Dent. 2007;19(5):271-272. doi:10.1111/j.1708-8240.2007.00115.x
25. Tennert C, Suárez Machado L, Jaeggi T, Meyer-Lueckel H, Wierichs RJ. Posterior ceramic versus metal restorations: A systematic review and meta-analysis. Dent Mater. 2022;38(10):1623-1632. doi:10.1016/j.dental.2022.08.002
26. Cheung W, Griggs JA, Powers JM. Mechanical properties of dental materials. In: Sakaguchi RL, Powers JM, editors. Craig's Restorative Dental Materials. 14th ed. Elsevier; 2018. p. 27-56.
27. Badri N, Mhamdi M, Ali RB, et al. Gold and Female Reproductive Organs: an Ultrastructural Study. Biol Trace Elem Res. 2018;183(2):280-287. doi:10.1007/s12011-017-1135-7
28. Gange P. The evolution of bonding in orthodontics. Am J Orthod Dentofacial Orthop. 2015;147(4 Suppl):S56-S63. doi:10.1016/j.ajodo.2015.01.011
29. Johnson R, Verrett R, Haney S, Mansueto M, Challa S. Marginal Gap of Milled versus Cast Gold Restorations. J Prosthodont. 2017;26(1):56-63. doi:10.1111/jopr.12432
30. Sorel O, Mano MC, Mehdi S. Collages particuliers (Specific bonding technics). Orthod Fr. 2009;80(2):193-202. doi:10.1051/orthodfr/2009013
31. Kelly JR, Benetti P. Ceramic materials in dentistry: historical evolution and current practice. Aust Dent J. 2011;56(Suppl 1):84–96. doi:10.1111/j.1834-7819.2010.01298.x

DOI: 10.18044/MEDINFORM.2025123.2152 ISSUE 3, 2025

32. Henry DB. A Clinical Presentation of the Direct Gold/Composite Sandwich Restoration. Oper Dent. 2022;47(2):123-130. doi:10.2341/21-034-T
33. Jongrungsomran S, Pissuwan D, Yavirach A, Rungsiyakull C, Rungsiyakull P. The Integration of Gold Nanoparticles into Dental Biomaterials as a Novel Approach for Clinical Advancement: A Narrative Review. J Funct Biomater. 2024;15(10):291. Published 2024 Sep 30. doi:10.3390/jfb15100291
34. Tijana A, Valentina V, Nataša T, et al. Mechanical properties of new denture base material modified with gold nanoparticles. J Prosthodont Res. 2021;65(2):155-161. doi:10.2186/jpr.JPOR_2019_581

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