Incorporating Gold into Ocular Prosthetics

ABSTRACT: *In the hope of improving motility, cosmesis, and comfort, many materials have been used to make prostheses over the centuries. While polymethyl methacrylate (PMMA) has been the primary material used in prosthetic eyes for the past 60 years, other materials, including various metals, have been incorporated into ocular implants. Gold's inherent qualities suggested its early use; its historical uses and possible future applications in ocularistry are presented here.*

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INTRODUCTION

Few materials have the history, value, and dependability of gold. Such terms as "gold standard," "golden," and "the Golden Rule," all demonstrate the value and mystique of this legendary element. Gold has been the international standard of luxury for millennia. In addition, the metal has many practical uses, including some in medicine and prosthetics.

A question may arise as to why this review of gold and its uses in various ophthalmic appliances, including ocular implants, is necessary. Considering that gold fell into disuse as an ocular implant material over 30 years ago, this is a fair question. This article illustrates its successful uses in the past, as well as what other uses have not been particularly successful. It documents a largely forgotten, obscure history. Although gold still has some uses in ocularistry, it is unlikely to be widely used again as its cost increases.

THE MYSTIQUE AND RECENT HISTORY OF GOLD

A recent *National Geographic* article[1] describes gold this way:

> No single element has tantalized and tormented the human imagination more than the shimmering metal known by the chemical symbol Au. For thousands of years the desire to process gold has driven people to extremes, fueling wars and conquests, girding empires and currencies, leveling mountains and forests. . . . [Its] chief virtues—its unusual density and malleability along with its imperishable shine—have made it one of the world's most coveted commodities, a transcendent symbol of beauty, wealth, and immortality. From pharaohs (who insisted on being buried in what they called the "flesh of the gods") to the forty-niners (whose mad rush for the mother lode built the American West) to the financiers (who, following Sir Isaac Newton's advice, made it the bedrock of the global economy): Nearly every society through the ages has invested gold with an almost

mythological power.

Humankind's feverish attachment to gold shouldn't have survived the modern world. Few cultures still believe that gold can give eternal life, and every country in the world—the United States was last in 1971—has done away with the gold standard.

Gold's chemical symbol (Au) is from the Latin *aurum* (glowing), and its atomic number, 79, places it just between platinum and mercury in the periodic table of the elements. It is a noble metal with a valence of 1 or 3. A highly sought-after metal, this naturally occurring mineral is found in grains, nuggets, and underground veins in rock and deposited in river sand. It has several crystalline structures, including wire, leaf, branch, and tree forms, often within quartzite formations.

Almost no new large surface deposits of gold have been found in a century. Now, 30 tons of rock must be pounded to dust in a stamp mill to extract 1 ounce of the metal. Thus, market demand has outstripped mining capacity for years. It is rare indeed; 90% of all the gold ever mined has appeared since 1838, and that total would only form a cube measuring 20 meters on each side. While only 5 atoms of every billion in rock are gold, the average human body contains nearly 1 part in every 50,000 (0.000045%) of gold.[2]

Seventy-eight percent of the gold mined today is used for jewelry manufacture. Industrial uses account for just 12%, and the remaining 10% is used in financial transactions. Because gold can be mixed with mercury but does not react with it, most gilding of bronze statuary up to the 20th century was performed with this solution. The mercury was later dissolved with heat and cyanide in a dangerous process. Gold does not dissolve in nitric acid, which readily dissolves silver and base metals. This fact is the origin of the colloquial term, "acid test," a test for genuine value.

Gold is the most malleable and ductile metal known. A single gram can be beaten into a sheet of gold leaf larger than 1 square meter, or an ounce into 300 square feet. This is so thin (nearly an atom thick) that it would take 250,000 stacked sheets to reach a height of 1 inch. Although gold leaf is usually thin enough to be translucent, the light transmitted through it appears greenish-blue because gold reflects yellow and red. Gold is 70% denser than lead, and even denser than uranium. It is also opaque to X-ray radiation.

Gold can be "ducted" (i.e., drawn through a die hole) to incredible thinness—easily 1/1000 of an inch. While this ductility means it can also be folded without breaking, heat treatment (annealing) is used to control its breaking strength. Thin gold wire can be woven like any other fiber, but gold only melts at temperatures of more than 1700°F.

Gold readily combines with other metals to form alloys, usually platinum, palladium, copper, silver, and rhodium. These alloys can be modified to increase gold's hardness or to create white, peach, rose, purple, or even "black" gold. A good conductor of heat and electricity, gold is unaffected by air and most reagents. Heat, moisture, oxygen, and most corrosives have very little chemical effect on gold, making it well suited for use in coins and jewelry; however, halogens, such as bromines and chlorines, will chemically alter gold, and freshly mixed aqua regia (a 1:3 combination of nitric and hydrochloric acids) dissolves it.

Gold is usually in an alloy of some kind, and these combinations are rated in terms of "fineness," "karat," or both. (see Table 1) Fineness is determined by the parts per thousand of pure gold contained in the alloy. Pure gold is 1,000 fine, so an alloy containing 750 of 1000 parts (three-fourths) pure gold is 750 fine. In the karat system, pure gold is 24 karat, while a 10-karat alloy is 40% gold, the smallest percentage that can be sold as gold.

Table 1 Formulas and measurements used with gold.

The conversion formula for karat to fineness is:

24 karat=1000 fineness

The troy system of weight is used for precious metals like gold and platinum. Gold alloys are recorded and issued by the troy system.

Troy System of Weight

24 grains (gr)=1 pennyweight (dram weight troy)

20 pennyweight troy (dwt)=1 ounce troy (oz.)

12 troy ounces (oz)=1 pound troy (lb.)

GOLD IN DENTISTRY

Gold and gold compounds have been used in dental prostheses and implants since antiquity. Around the 8th and 9th centuries B.C., wealthy Etruscan women wore dental prostheses with gold wires. These prostheses were also seen in other cultures of the same period, such as the Egyptian and Phoenician. Later, the Romans and other subsequent cultures, such as the Chinese Ming dynasty (1368 to 1644), developed the art of making gold alloy dental prostheses and implants. Teeth unearthed from Ming dynasty burial sites include gold-copper alloy crowns that were hammered and welded into shape and attached with zinc-based cements. European and African remains from the 18th and 19th centuries reveal that gold was used in ligatures for splinting teeth as well as in inlay, onlay, and full-coverage crown prostheses.

Today, dentists still use gold to fabricate restorations, wires, or prostheses to restore form and function of existing or missing teeth. Gold alloys are used in restorative dentistry, especially in tooth restorations, such as crowns and permanent bridges (Figure 1). The malleability of gold alloys facilitates creation of a superior mating surface with other teeth and produces results that are generally more satisfactory than porcelain crowns. The use of gold crowns for prominent teeth such as incisors is favored in some cultures and discouraged in others.

Casting gold alloy is used for various types of dental restorations. Restorations made with gold foil do not have the same strength and resilience as restorations made with gold alloys, which are melted and cast using the same lost-wax technique known to Egyptian and Aztec goldsmiths. Four types of casting gold alloys are used in dental implants and restorations: soft for inlays not subject to stress; medium for ordinary inlay dental work; hard for full crowns, three-quarter crowns and retainers; and extra-hard, for saddles, clasps, and one-piece cast partial dentures. Casting gold alloys can be whitened to be less noticeable by adding palladium, platinum, or silver, thus creating white gold.

GOLD IN MEDICINE

Though gold's unique physical and chemical properties have made it invaluable in medicine, it has long been used regardless of proven effect. More than 3,000 years ago, gold was used to make reconstructive plates for human skull defects. The Chinese used gold in treating smallpox and measles, and the Japanese ingested thin gold foils for their health benefits. The ingestion of gold is mentioned in the Bible (Exodus 32:20), and gold appears in therapeutic preparations in other ancient cultures. In India gold was used as an analgesic, while in Egypt only royalty were allowed to consume it.

In the 16th and 17th centuries, Western cultures used gold preparations to treat a variety of disorders including epilepsy, sterility, and ailments of the uterus. During the mid-19th century, gold was considered an effective treatment for drug addiction and alcoholism. By the end of the 19th century, gold was listed as a therapy for insomnia and various nervous disorders. These additions to the formulary appeared at approximately the same time as gold was discovered in the United States and Canada. Although they may have been market-driven, patients who bought gold cures potentially gained monetary wealth, if not health.

Application of Gold in Medicine Today

Gold implants have been successfully used in reconstructive surgery of the middle ear. When tympanoplasty is performed because of cholesteatoma, chronic otitis media, adhesive otitis media, or trauma, gold is often used in partial or total reconstructive prostheses. In ossicular replacement, gold exhibits a high degree of biocompatibility; in one study of 59 patients, no implant rejections were encountered.[3]

Because gold resists bacterial colonization, it is a desirable material for implants at high risk for infection, such as gold myringotomy tubes. However, some data indicate that a titanium coating may be a better choice because its surface adhesion properties and micro-surface smoothness appear superior in both *in vivo* and *in vitro* testing.[3]

Therapies that are more effective have now replaced gold in most medical applications, with the possible exception of rheumatoid arthritis. Although the use of gold has markedly decreased since it began in the 1920s, it has been one of the standard treatments for other types of arthritis since the 1960s. Though its mechanism of action is not well understood, it appears to alter the process responsible for joint swelling and pain.

New medical uses for gold have been developed. Physicians treating rheumatoid arthritis use gold salts, such as the injectables gold sodium thiomalate and gold thioglucose, or complex gold-containing salts, such as auranofin, which are taken by mouth. Gold therapy for some types of arthritis results in alleviation of joint pain and stiffness, decline in swelling and bone damage, and reduction in joint deformities. A recent study comparing the effectiveness of injected gold to high-dose methotrexate for treatment of rheumatoid arthritis showed no significant differences but some advantages for gold, suggesting that modern and expensive agents may not be better than the oldest disease-modifying antirheumatic drug known: gold.[3]

Another medical use of gold is as an antibacterial coating for voice prostheses. After a laryngectomy, some cancer patients receive voice prostheses as part of their rehabilitation treatment. Over time, the prosthesis is often colonized with bacteria and its sound function deteriorates. In 2 months to 4 months, it is also overlaid with a fungicide-resistant *candida albicans*. Because of its physical properties and ability to prevent adhesion of microorganisms, the surfaces of these implants are coated with gold to maintain stability of the implants.[3]

To aid in positioning, a radiopaque coating containing gold has been added to endovascular stents. However, studies have shown that simply gold-plating the stents resulted in adverse hyperplastic tissue responses under certain conditions. As a remedy, the gold surfaces are smoothed by a post-plating thermal processing.[3]

Most recently, gold has been used in the manufacture of drug delivery microchips. These microchips contain reservoirs filled with drugs, which are sealed and protected by thin gold membranes. The microchips are then implanted, swallowed, or integrated into an intravenous delivery system. Via remote control or biosensors, the patient or physician can initiate exacting drug dosages by transmitting a small electric current to the gold barrier, beginning the disintegration of the membrane, and allowing release of the drug.[3]

Studies of gold for antitumor treatment began after observations of lower malignancy rates in arthritis patients treated with gold.[3] Gold displays some curious antitumor properties, and it is sometimes used in implants to fight cancer. Some forms of cancer are treated with colloidal gold, a material that incorporates nanoparticles of gold in a liquid suspension. Colloidal gold is also used as an indicator for diagnostics of the immune response system. Other forms of gold, such as radioactive gold grain implants, are used as salvage treatments for persistent and recurrent nasopharyngeal cancer. Microscopic gold pellets may be used as seeds in prostate cancer treatment, implanted either as a gold isotope (half-life, 6.2 days) or as a coating on other radioactive materials.

One of the less frequent applications of gold is in breast implants. As an alternative to silicone-filled implants used for cosmetic enhancement or reconstruction after mastectomy, the MISTI and MISTI II breast implants were filled with a polyvinylpyrrolidone hydrogel that contained gold powder. The gold was included to improve radio-opacity for follow-up and the biocompatibility of the gel if released; however, the material was not deemed entirely safe for long-term use in the body. Many patients found them unsatisfactory and had them removed.[4]

GOLD IN OPHTHALMOLOGY

Today, ophthalmic plastic surgeons use gold implants as weights to restore upper eyelid function. Patients with lagophthalmos are unable to close the upper eyelids completely, putting the eyes at risk of corneal drying, especially during sleep and subsequent ulceration. While this condition is still treated in developing countries by tarsorrhaphy (sewing the eyelid half shut), the current standard of care is the surgical insertion of gold implants into the upper eyelid, which are sutured to the anterior tarsal plate. Relaxation of the levator palpebrae superioris allows gravity to help the gold weight close the lid[5] (Figure 1). While complications, such as astigmatism, pseudoptosis, migration, bulging, and extrusion, have resulted from the use of gold upper lid implants in patients with facial palsy,[2] these adverse effects are more likely the result of pressure on the eye than a reaction to the implant material.

Figure 1 Gold is a material with diverse uses in medical implants and devices from voice prostheses to breast implants. These images include some of the more common appliances and several uncommon ones. A) 12-karat gold eyelid weight; B) Partial flipper denture with 12-karat gold framework; C) Four-unit dental bridge in 12-karat gold, c. 1944; D) Single unit 12-karat gold crown; E) Silicone prosthetic ear shown with 12 karat gold clips included in the posterior (2010); F) 10-karat gold-framed spectacles, c. 1950; G) Copper cranial implant with gold studs for securing, c. 1944; H, I) Cutler-type ocular motility implant, incorporating gold bar with pink PMMA, c. 1952; J) Hollow gold ocular implant, c. 1932; K) Gold-plated ocular conformer, c. 1929; L) Postoperative arthroplasty X-ray of a gold-plated hip implant in situ; M, N) Surgeon's enucleation and ocular implant kit assembled by Southern Optical of Louisville, Kentucky, including gold and glass sphere implants and stock glass ocular prostheses. Price list is on the bottom of the wooden box, c. 1932.

Spectacle frames made from gold or gilded metal may be considered more of a fashionable item than a medical necessity (Figure 1). Nonetheless, they have been in use for centuries. According to the editor of *Ophthalmic Antiques,* the newsletter of the Ophthalmic Antiques International Collectors Club, spectacle frames of "gilded silver" were first mentioned in 1321. This is the first known mention of metal spectacles. Later, the bishop of Orvieto, Italy, owned a pair of crystal lenses with gilded copper frames (Ronald J.S. MacGregor, personal communication with the author, March 21, 2009).

Gold Sphere Ocular Implants

In both restorative dentistry and ocularistry, the materials used have evolved over time, including gold and plastics in both fields. It would not be surprising if gold were incorporated into ocular prosthetics because of this past dental relationship, especially as techniques from the field of reconstructive dentistry were used to create the modern ocular prosthesis. By some accounts, however, gold has a long history in ocularistry, having been used as early as the 18th century to make ocular prostheses.[6]

Surgical techniques for eye removal were first recorded in Europe in the late 16th century. Modern surgical enucleation was first described by O'Farrell in Dublin and Bonnet in France in 1841,[7] approximately the same time as general anesthetics, such as nitrous oxide, chloroform, and ether, came into use. The use of anesthesia not only made enucleation more humane, but also it allowed doctors time to develop better surgical techniques. By 1884, Knapp reported the use of retrobulbar injection of cocaine for enucleation.[8] Originally, enucleation involved simply removing the eyeball from the orbit, packing the socket with iodine-treated gauze, and providing a prosthetic eye when the socket healed. In early enucleation surgeries, the socket was left empty, so any ocular prosthesis tended to sink back as the orbit healed and developed a large superior orbital cavity. Over the years, the positioning of ocular implants was introduced to help reduce the loss of volume and improve motility of the prosthesis.[6] In 1884, Philip Henry Mules of Manchester, England, introduced the hollow glass sphere implant, widely considered the first successful ocular implant. References to Mules' operation, as in Figure 2, are a gesture to this achievement.

Once the glass sphere ocular implant was developed, its limits were felt; glass spheres could fracture with sudden changes in temperature or altitude or with the rare blunt injury to the orbit. With the aim of reducing migration while restoring volume and improving motility, many other materials were tried, including agar, aluminum, charred bone, cork, ivory, rubber, silver, petroleum jelly, silk, wool, fat, peat, catgut, and sponges. Most of these implants failed for one reason or another.[7,9-11]

As early as 1902, the thin gold sphere was praised as being easier to handle than the glass sphere, which was sometimes fragile. This made gold one of the next successful ocular implant materials. Fox proposed the use of hollow gold spheres in 1902, arguing that gold was less likely than glass to irritate the orbital tissues and be extruded.[12] The malleable metal allowed implant makers to create a smooth convex shape to complement the concave posterior design of a mouth-blown glass ocular prosthesis. Gold ocular implants may also have been something of a status symbol, despite being unseen. While suppliers of gold implants may have reinforced this view, the status of gold and its reputation for quality has likely played a role in its marketing in many quarters.

From a practical standpoint, gold balls may have been more convenient for United States surgeons and ocularists to purchase than German-made hollow glass spheres, particularly during World War I and II when trade with Germany was limited. Although gold ocular implants' popularity may be attributed to regional success, this cannot be underestimated in determining the reasons for longevity of use. From a historical perspective, as with other ocular implants, gold ball implants may be extant due to their disuse rather than their popularity.

Regional variations in the popularity of materials may also account for the longevity of the mouth-blown glass ocular prosthesis, which is still popular in Germany, Eastern Europe, Russia, and some areas of China, but seen as antiquated in North America and parts of Western Europe. Production and demand, success in niche markets, and reimbursement by various insurers—including national health systems—are important factors in determining what materials are used for prosthetic eyes and

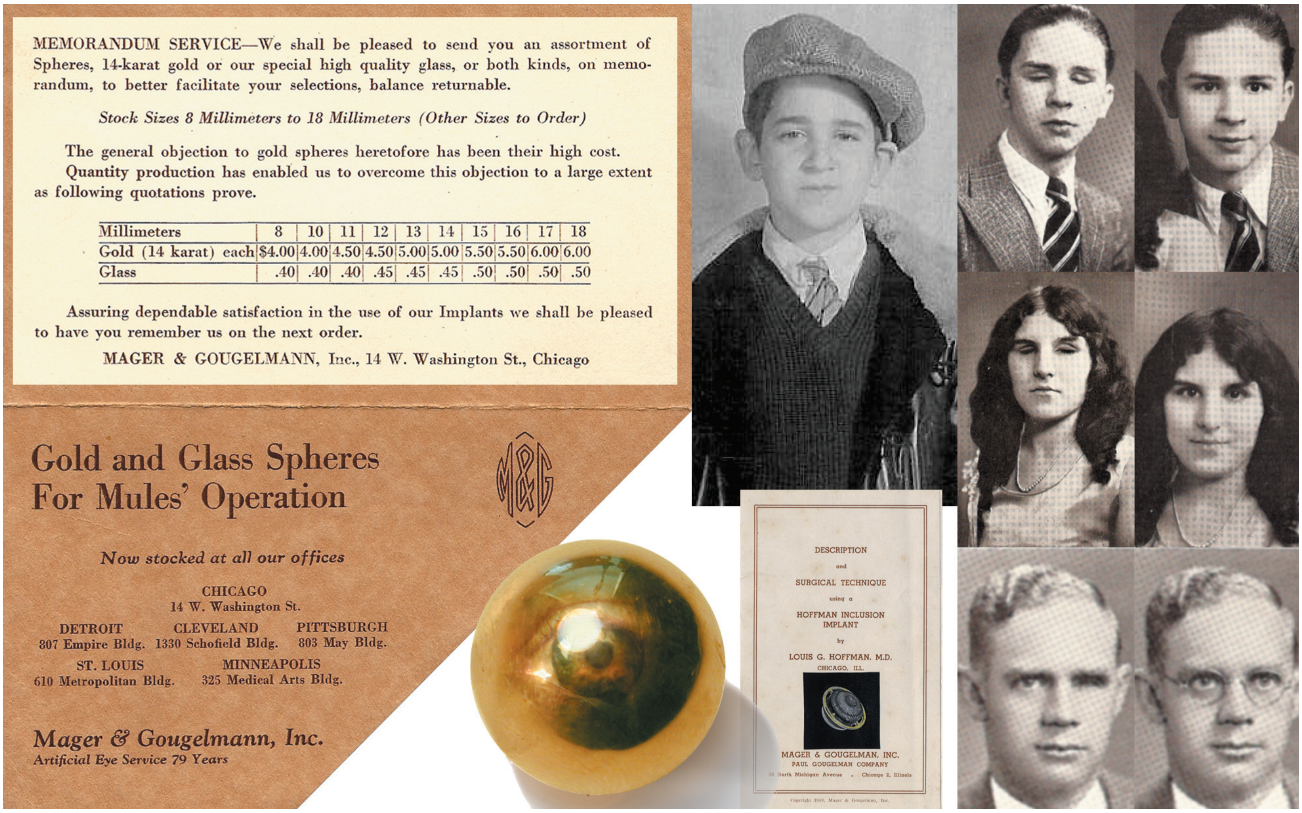

Figure 2 The brochure shown above (cover at left), c. 1933, was distributed by ocularist Paul Gougelman of Chicago to Midwestern ophthalmologists. It lists sizes and prices for gold ocular implants. At the time, marketing implants and prostheses was rare. Gougelman and C.E. Biel, founder of Denver Optic, were pioneers in marketing their ocular prosthetics businesses. Photos inside the Gougelman brochure depict patients with bilateral enucleations (man top right, woman center right) before and after receiving gold ocular implants and glass prostheses. The man in glasses (bottom right) and boy with cap (center top) are examples of monocular patients wearing gold spheres and glass prosthetic eyes, both in the left eye (OS). The Louis G. Hoffman, M.D., brochure at bottom center shows another implant incorporating gold that Gougelman sold.

ocular implants.

Paul Gougelman of Chicago, ocularist and entrepreneur, was an important distributor of the hollow 14-karat gold sphere ocular implants most popular in the 1920s and 1930s (Figure 2).[13] Their simple design, straightforward surgical implantation,[13] and long-term biocompatibility made the gold ball implant the material of choice as it slowly replaced the glass sphere implant. Gold-plated conformers were often used to complement the implant during the healing process (Figure 1). Gougelman also distributed the Hoffman inclusion implant, which incorporated gold. In 1949, ophthalmologist Louis G. Hoffman, M.D., developed an implant consisting of a ball covered with tantalum mesh with a 19- mm gold ring attached to the anterior face. Success, as with many ocular inclusion implants, was short-lived (Figure 2).[14]

Despite these advantages, gold ocular implants were far from perfect. Simply put, the implant migrated along the path of least resistance (Figure 3).[15-18] The implant migrated to the superotemporal side of the orbit, which is also known as the weakest quadrant of the posterior Tenon's (because of its position under the lacrimal gland), a common route to extrusion (Figure 4). Perhaps because of this migration, the implant's popularity declined during the 1940s as other implant materials and various types of motility implants became more common. The rising price of gold may have been another factor in the decline in gold implant use.

For many decades, the U.S. Treasury fixed the

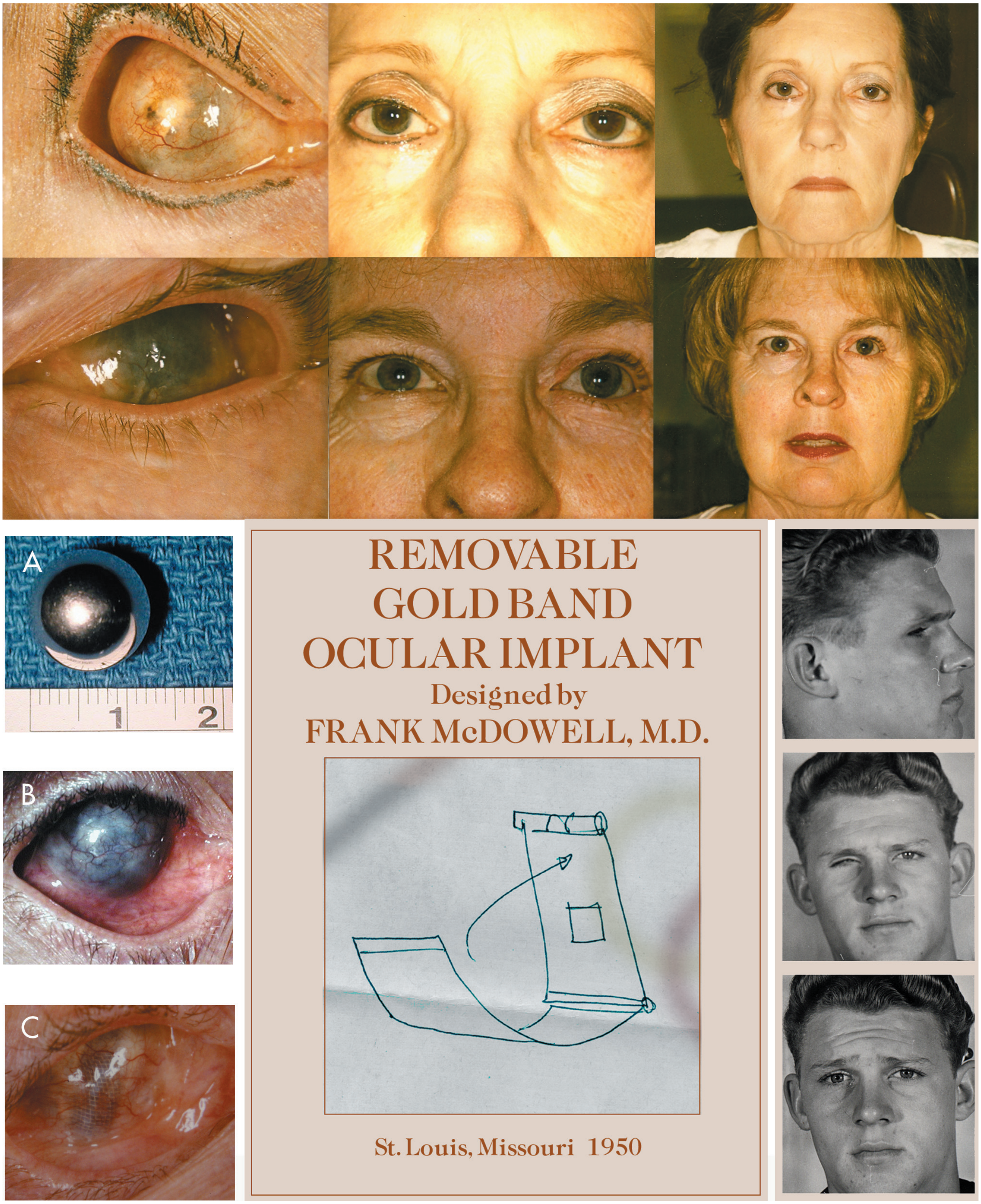

FIGURE 3 Migration is a concern with ocular implants. The above progressive close-ups show two women with and without their prosthetic eyes. Close review shows migrated gold spherical implants. Note that in some patients, the metal implant appears dark, with a thin covering of conjunctival tissue. The rare gold mesh ocular implant, possibly a single promotional item, is also visible following migration (C). Another unique implant, which might have been a single promotional item, was the Removable Gold Band Ocular Implant designed by ophthalmologist Frank McDowell, M.D., of St. Louis, Missouri (lower right). Note the simple design. A monocular patient is shown wearing the implant (far lower right).

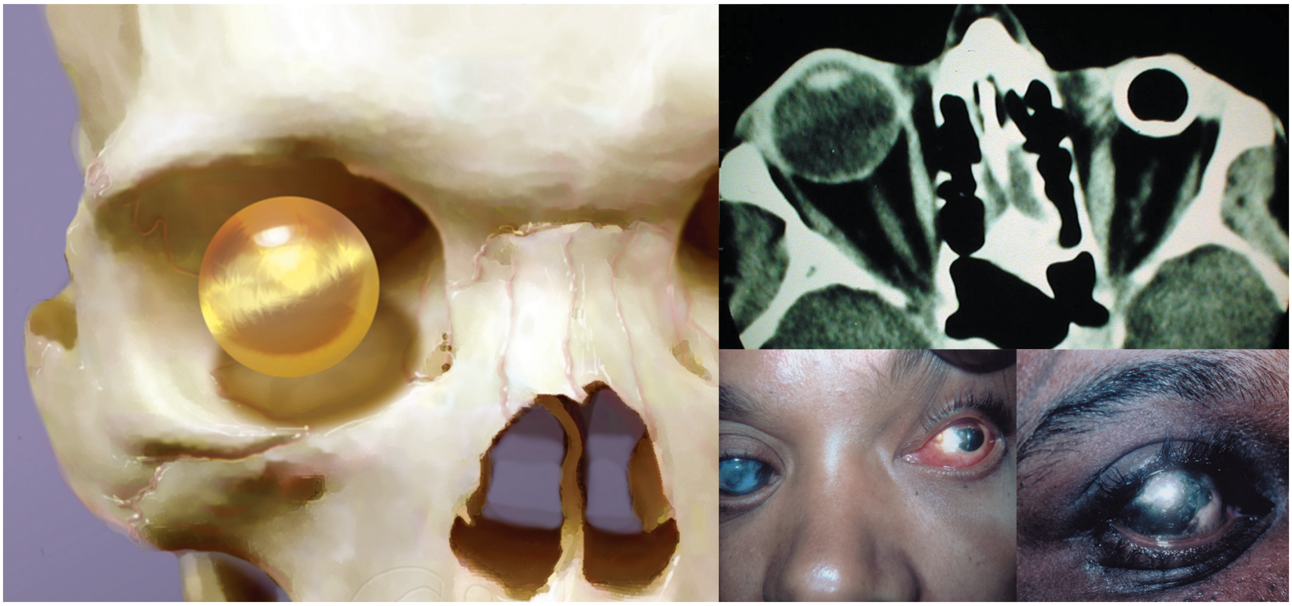

FIGURE 4 Surgical technique and implant positioning within the orbital cone are keys to success with any implant. The illustration at left and the MRI at right show a correctly positioned gold sphere implant in the right eye (OD) from the front and above. Migration, extrusion (below right) and the rising price of gold were factors in gold's decline in use in all implants and durable medical equipment. A safety question may arise when patients with ocular implants have magnetic resonance imaging (MRI). While most gold ocular implants are not ferromagnetic, MRI may be contraindicated in patients whose implants contain stainless steel.

price of gold by the ounce at $20.67 until 1934, when it was increased to $35.00; simultaneously, the U.S. Mint took the $20 gold double eagle out of circulation and melted down more than 450,000 coins to generate funds for the New Deal. While it is difficult to determine if this change in price actually led to the decline of the gold ocular implant, dental restorations also saw a rapid decline in gold use, most likely due to costs that increased 75% overnight.

Despite their decline in popularity in the 1940s, gold sphere implants continued to be used for a number of years.[19-22] The development of polymethyl methacrylate (PMMA) as an implant material inspired many creative ocular implant designs incorporating plastics with metals. While gold was used with PMMA (Figures 1, 5 and 6), titanium was used more frequently. Several "designer" motility implants of the 1940s proved vulnerable to migration and infections, and required tedious prosthetic fittings. These factors allowed the simpler, time-tested gold sphere ocular implant to stay relevant through the 1960s and even in the early 1970s, if there was a surplus in the operating room supply cabinet.[23] Many an eye surgeon displays an extracted gold ball as a curiosity. Finally, the quasi-integrated PMMA implants, including the Allen and Iowa implants, the simple spherical PMMA implant and later, the silicone spherical implant led to the virtual disappearance of the gold sphere implant. There are, however, still uses for the metal.

Gold Motility Pegs

Ocular motility pegs have been incorporated into ocular implants for various reasons, including improving the movement of prosthetic eyes, providing greater support for the prosthesis, and relieving pressure on the lower, inner conjunctival fornix.

Motility pegging systems have evolved from simple integration to the "double shaft," as depicted by Gilliand, Harrington and Trawnik, and others.[24,25] A comprehensive overview of pegs and peg types was assembled by Danz and Hadlock.[26] Innovative systems are used to enhance motility, reduce the chance of dislodging the prosthesis, and minimize lateral gaping on extreme eye movements (Figure 5).[25-28] However, careful peg positioning by the surgeon and exacting prosthetic fitting are criti-

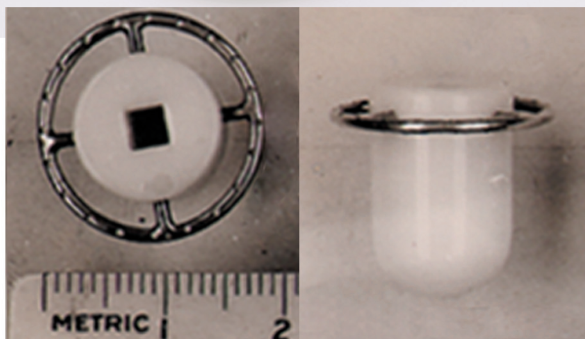

FIGURE 5 Gold has been used in motility ocular implants. The photos at top, taken in the mid-1940s, demonstrate one patient's capacity for considerable lateral eye movement while wearing a Cutler motility implant with a custom ocular prosthesis. At center is an artist's rendering of a Cutler peg-type prosthesis motility implant, with a gold motility peg shown at left and gold bars at right. The peg is attached to the posterior of the ocular prosthesis. The inset photos at lower right show a motility implant with a circular gold bar.

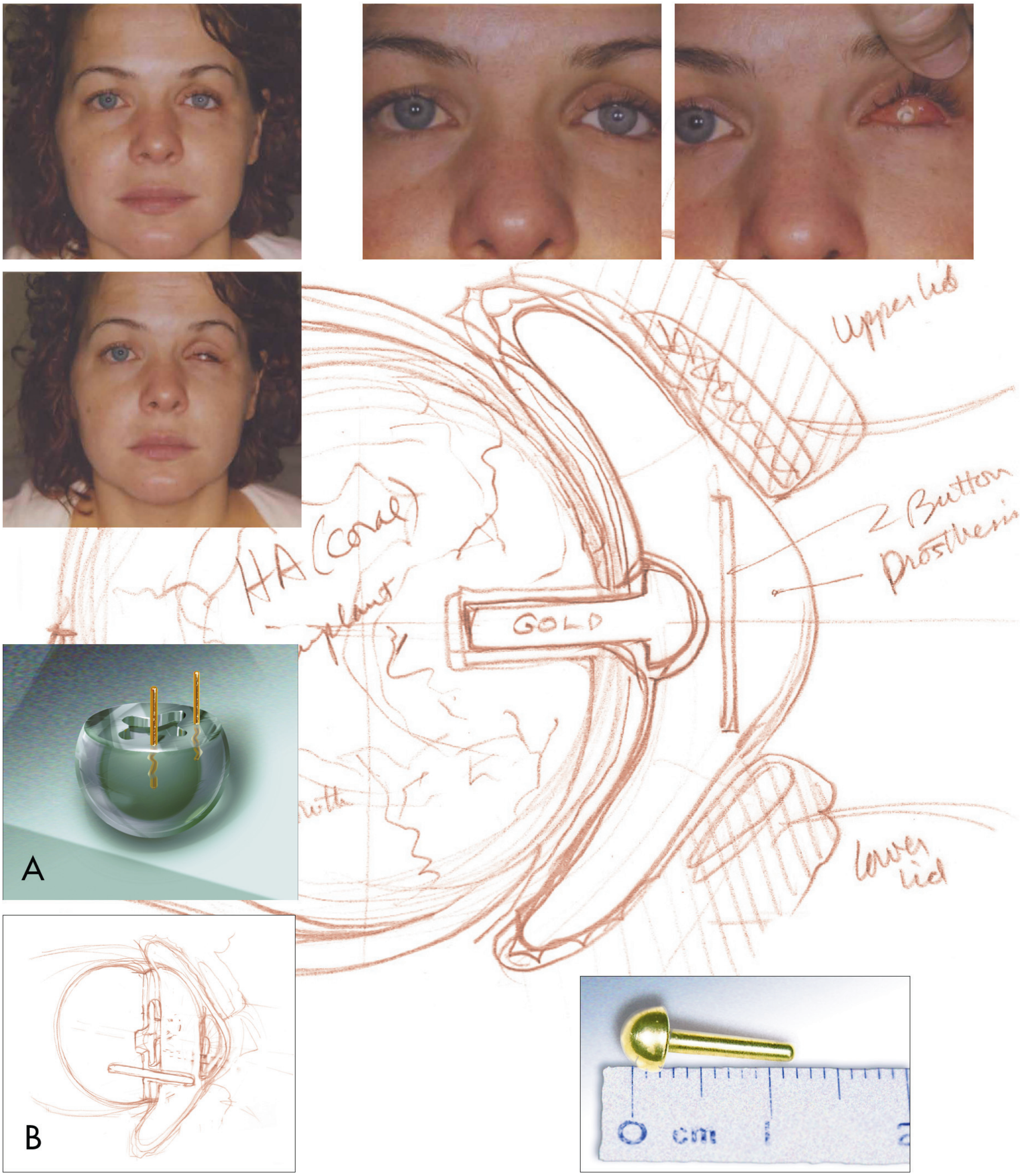

FIGURE 6 Pegging systems used with ocular implants and prostheses have had varying degrees of success, with and without gold, over the last 70 years. The four photographs at top left and right show a patient wearing an ocular prosthesis with a motility peg. The two illustrations at lower left (A, B) show an unusual gold double shaft from the 1940s (Arruga implant). This greatly increased a patient's eye motility; unfortunately, the implant was vulnerable to migration and infections. The background illustration of a hydroxyapatatite (coral) implant uses the similar idea of a motility peg. A gold post motility peg is shown at bottom right. This creative design and use of a less porous pegging material was developed for a patient with chronic mucus discharge.

cal to the success of this procedure; complications can sometimes arise.

Gold Motility Peg: A Case Report

A 30-year-old woman who had undergone enucleation 15 years earlier presented to our clinic for treatment of significant mucus drainage around her prosthetic eye. She was originally fitted with an 18-mm hydroxyapatite implant and had subsequent pegging without a plastic/titanium sleeve. This situation is not uncommon for people with motility implants and motility pegging systems. It may be one reason that patients who wear prosthetic eyes do not always use motility pegs. As both ophthalmologists and ocularists have found, the mucus drainage that prosthetic eyewearers experience can sometimes be difficult to diagnose and treat, sometimes falling between the specialists' areas of expertise.[29,30]

In this case, the patient was using several daily medications to treat the mucus drainage. It was thought that the porous material of the plastic motility peg might have created a reservoir for bacteria, causing the irritation, but the patient did not want to discontinue using the motility peg. Since gold resists bacterial colonization and seems to accommodate tissues better, we offered the simplest alternative: casting a solid gold motility peg to replace the plastic one.

Using a spare plastic motility peg, a sprue was attached and molded, then cast in 12-karat dental gold using the centrifugal lost-wax casting method in a dental laboratory. Smoothed, highly polished after release, and sterilized, the 4- mm shaft fit perfectly in the hole formerly occupied by the plastic peg. In this case, the patient did tolerate gold better than plastic, and was able to reduce her use of medications to a silicone lubricant for her "dry eye" (Figure 6).

CONCLUSION

A wide variety of materials is available for ocular and orbital reconstruction. In this article, we describe a material very familiar to the mainstream practitioner, one that has not always received equal attention with other materials. A continued standard of material and cultural wealth, gold also continues to play a role in medicine and occasionally in ophthalmic plastic surgery and ocularistry. Our case report confirms that it is still well tolerated as an implant material.

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