

History of restorative dentistry

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Abstract

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Keywords

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The first evidence of tooth restoration is from 11,000 BCE, Upper Paleolithic. In dental specimens found in Tuscany, Italy, the exposed pulp chamber of two anterior teeth has been enlarged using flint stones and restored using bitumen, vegetable fibers, and probably the hair (1). More recent evidence of restorative intervention using beeswax comes from 4500 BCE. The Lonche jaw, found in Slovenia, showed a lower left canine had traces of restoration. The first-century Roman physician Celsus recommended scraping the black portion from the cavity and filling the tooth with a mixture of rose leaves, nutgalls, and myrrh.

The subsequent significant development in the history of tooth restorations occurred in 1460 when Giovanni d'Arcoli, of Bologna used gold foil to fill teeth (2). Giovanni da Vigo of Rapallo, personal physician to Pope Julius II in 1514, went one step further, cleaning carious teeth before filling them with gold foil, using *drills, files, and scrapers (trapano, lima, scalpo)*.

A significant advancement in techniques, instruments, and approaches to dentistry comes from Ambroise Paré, a practicing barber-surgeon. He designed new surgical instruments, extraction tools, obturators, gentle wound healing, and arterial ligation techniques. Paré still believed in the *tooth worm* and suggested applying *something caustic, hot, dissolved in vinegar or theriac*. In that same spirit of using a caustic agent, Johann Heurnius, a Dutch professor of medicine, suggests the use of sulphuric oil to destroy the dental pulp and to reduce the roughness and sharp edges of teeth. An alternative to gold restorations comes from Jacques Guillemeau, in 1612, who used a mineral paste made of mastic and coral powder.

Compared to gold or mineral paste, a cheaper and more reliable alternative was lead or tin. Pierre Fauchard, the “Father of dentistry,” described materials and tools for restorative dentistry (3). Fauchard used files, an Archimedes-type drill, and sharp instruments to enlarge a cavity and remove decay, cauterized the cavity with a hot instrument, and then filled it. The French word for *lead* and a *dental filling* is the same, *plombe*.

In 1840, Wolfsohn of Berlin developed a quick-setting restorative material made of Sandarac, a resin from a small cypress-like tree, chalk, and mastix mixed with ether. However, the restoration required frequent replacements because of its foul odor. During the 19th century, there was a need for a material that would not harden too quickly or could be removed at the next appointment. Gutta-percha appeared to fit the purpose. Isolated in 1842, gutta-percha was first used in 1847 by Edwin Truman as a temporary restorative material.

In 1840, Charles Sylvester and A. Rostaing, a father-son team from Dresden, Germany, developed a new cement containing zinc oxide and phosphoric acid. A much more advanced cement came in 1892; Otto Hoffmann developed a high-quality zinc phosphate cement. Parallel with the development of dental cement, there was a need for an esthetic restorative material for anterior teeth. In 1878 the “translucent cement” of Thomas Fletcher in London was patented (4). A more successful and esthetically pleasing cement was formulated by Paul Steenbock, a Berlin chemist, in 1903. It contained zinc oxysulfate cement, aluminum beryllium, calcium oxide, and silicic acid.

Because acidic components of several restorative materials caused pulp damage chemically or by transmitted heat, cavity liners with asbestos (1846) or calcium hydroxide (1930) were developed. Since then, zinc oxide eugenol, glass ionomers, and resin-based liners have been employed.

Eugenol and isoeugenol, extracted from cloves and nutmeg, respectively, have been used to reduce dental pain and pulp inflammation. Zinc oxide eugenol was used as part of the temporary restoration for the better part of the 20th century. Nutmeg, which contains clove oil, in the 17th century, was considered powerful enough to ward off the plague. It was highly prized as a spice and source of herbal remedies. The Dutch, who dominated the spice trade in the 17th century, based on the Treaty of Breda in 1667, traded the island of Manhattan to the British in return for the spice island of Run, rich in nutmeg. Nutmeg is the reason Manhattan speaks English today and not Dutch.

Composite bonding agent was introduced to dentistry in 1955. It started with the Swiss chemist Hagger with a dentin bonding agent, but Michael Buonocore (5) 1955 established the field of acid etch technique for bonding to dentin and enamel. Since its introduction, several generations of bonding agents have emerged, from no-etch to total-etch to self-etch, with constantly improving qualities. Today's composite agents are dentin-adhesive with either an etch and rinse or a self-etch system.

Amalgam has been the focus of dentistry for at least 200 years. The first mention of amalgam is in 659 CE as *silver dough* in Su Kung's *Materia Medica*, a compendium for healing in ancient China. It resurfaced in several Chinese publications over the following centuries, including *The Essentials of Materia Medica*, in 1505. Its composition is also displayed: 100 parts mercury, 45 parts silver, and 900 parts tin.

Amalgam used specifically for dental filling appears in a prescription of *Praxis*, a 1528 work of Johannes Stockerius, a German physician. The first in situ amalgam restoration was discovered in a grave dated to 1601 north of Munich, showing a molar restoration with gold foil and amalgam.

Sir Isaac Newton, 1686, developed a low-melting fusible metal alloy containing eight parts bismuth: five parts lead: and three parts tin. That alloy was the basis of dental amalgam more than a century later. In 1818 Louis Nicolas Reignart suggested adding a mixture of mercury at a ratio of 1:10 to create dental amalgam. Upon heating, it became malleable and placed in small increments into the dental cavity, and one could shape it into the desired form. Further modification, by adding cadmium, copper, pulverized silver, and coin shavings, altered the handling property of amalgam. During the next decade (1826-1835), August Taveau tinkered with its composition using pulverized silver and mercury, creating a silver paste. In 1848 Thomas Evans of Philadelphia used a modified ratio of cadmium: tin: silver 1:3:1 ratio to improve it. Finally, in 1855 Elisha Townsend of Philadelphia suggested a 4:5 silver: tin ratio for amalgam, a composition that has endured for decades.

There was a unique period in American dentistry related to amalgam called *The Amalgam War*. It had to do with Edward and Moses Crawcours, uncle, and nephew team of London, making a trip to the East coast of America in 1833 using silver coin shavings instead of pulverized silver to create their “secret” mix of *Royal Mineral Succedaneum*. Opposition to amalgam among local dentists grew, leading to a campaign to ban amalgam and send the Crawcours back to Europe primarily because the two untrained dentists became financially successful and siphoned away many patients. The ban on the use of amalgam was lifted around 1850.

Cavity preparation was a particular point in the history of restorative dentistry, particularly for amalgam restorations. The most crucial individual that stands out in its development is Greene Vardiman Black, a dentist, and educator at the end of the 19th and beginning of the 20th century. His 1908 book *Operative Dentistry* and the principle of *extension for prevention* in cavity preparation dominated most of the 20th century.

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Figure 1. Timeline of Restorative Materials