Significant Events in the History of Operative Dentistry

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Numerous events have transformed the practice of operative dentistry into one that is more efficient and more comfortable for the patient as well as for the operating team, and, often, one that is more productive for the dental office than it was previously.

A number of significant occurrences in the history of operative dentistry can be studied by grouping them into the categories of analgesia and anesthesia; etiology, diagnosis and treatment regimes; equipment and devices; direct restorative materials; indirect restorative materials and illumination and magnification.

This article presents a narrative that traces these significant events along categorical lines and a chronology of events in the development of the art and science of operative dentistry.

Introduction

During the mid-1800s, the field of operative dentistry encompassed all of chairside dentistry. In an 1889 textbook, “Operative Dentistry,” oral surgery and fixed prosthetics were still included in the area of operative dentistry. It was only later that the branch of operative dentistry as we know it today, came into being, after prosthetics, oral surgery and other disciplines broke off on their own.

This paper presents the key events in the history of operative dentistry in topical fashion. Within each topic, the events are presented chronologically. At the end of the paper, a table summarizes the chronology of events.

Analgesia and Anesthesia

Prior to the introduction of ether in 1842 by Morton and nitrous oxide in 1844 by Wells, there was little that could be done to obviate the discomfort associated with the performance of operative dentistry. And, since these agents were used principally for analgesia or anesthesia during extractions and other surgical procedures, most patients did not experience anesthesia until after the introduction of conduction anesthesia in the late 1800s.

In 1884, Carl Koller discovered the analgesic properties of cocaine. Shortly after, in that same year of 1884, William S. Halsted introduced conduction anesthesia by
using cocaine to block the inferior alveolar nerve. \textsuperscript{3} Although cocaine was effective for achieving profound anesthesia, it proved to be highly addicting.

In 1904 or 1905, procaine was synthesized by Einhorn and Uhfelder in Germany.\textsuperscript{4,5} When mixed with a very small proportion of epinephrine, this agent was found to be highly effective and safe as a local anesthetic agent for most patients.

Procaine (Novocaine\textsuperscript{®}) was widely used by physicians and dentists into the 1950s and Novocaine\textsuperscript{®} is still the name that patients commonly associate with local anesthetics.

By the 1950s, lidocaine (Xylocaine\textsuperscript{®}) became widely accepted by the dental profession. This agent, developed in 1943,\textsuperscript{6,7} was found to have extreme safety, surpassing that of Novocaine\textsuperscript{®} and lidocaine became a widely used anesthetic agent.\textsuperscript{8} Although many other local anesthetic agents are currently in use and nitrous oxide is often used for its analgesic effect, lidocaine remains the principal anesthetic in routine use.

**Etiology, Diagnosis and Treatment Regimes**

Little was known of the causation of dental caries and no scientific basis existed for infection control prior to the second half of the nineteenth century. Antiseptic agents were known to surgeons during the American Civil War but they were misused.\textsuperscript{9} By 1865, Louis Pasteur came to the conclusion that microorganisms caused putrefaction and could be transferred from one place to another by solids or liquids as well as by airborne means.\textsuperscript{10} He also discovered that some microorganisms could be destroyed by heat or other methods. His work provided the basis for the "germ theory" of infection. Joseph Lister is considered to be the discoverer of antisepsis. In 1867, he published papers countering the accepted idea of "laudable pus," building on and complementing the work of Pasteur.\textsuperscript{11} Then, it was Robert Koch who cultured microorganisms, separating and classifying them.\textsuperscript{12} Among other things, Koch discovered the bacilli that caused tuberculosis and cholera. After considerable research, Willoughby D. Miller published his chemobiological theory of dental caries in 1890.\textsuperscript{5} Thus, the foundations of microbiology and infection control were firmly established in the medical and dental professions in the latter half of the nineteenth century. The value of and methods for sterilization of dental instruments were recognized by the late 1800s, but it wasn't until 1966 that the American Dental Association went on record stating that the best method for the sterilization of dental instruments was by means of saturated steam under pressure.\textsuperscript{13}

The venerable G.V. Black was almost single-handedly responsible for the development of the scientific cavity preparation, his work being published in 1891.\textsuperscript{14-18} Although preceded in his work on dental nomenclature by others, Black was the major author of the modern system of nomenclature, presented in 1893.\textsuperscript{19} Two years later, in 1895, x-rays were discovered by Wilhelm Conrad Röntgen.\textsuperscript{20} During the next year, Dr. C. Edmund Kells adapted the new discovery to dentistry.\textsuperscript{21,22} However, even by 1930, fewer than half of dental school graduates purchased x-ray machines when first equipping their offices. The advancements in dental radiology have been traced in an historical article by Frommer.\textsuperscript{23}

Another significant advancement for operative dentistry was the introduction of dental hygienists. This occurred in 1906 by Dr. Alfred Fones, who established his own school of dental hygiene.\textsuperscript{24-26,27,28} With the addition of a dental hygienist, the dentist was free to perform more operative procedures and had a valuable auxiliary to aid in the treatment and education of patients. Not to be left out is the significance of the earlier adoption of dental assistants into dental practices. This occurred in the late 1800s. Among those who utilized dental assistants early on was Dr. C. Edmund Kells.

By 1874, it was recognized that fluorine had a preventive effect on dental caries. This recognition was to have far-reaching effects. During the first three decades of the 1900s, Dr. Frederick McKay of Colorado Springs observed that mottling of enamel was confined to specific geographical locations. McKay and Dr. H. Trendley Dean showed that fluoride that was naturally-occuring in water caused the mottling. Later, Dean demonstrated that by adjusting the level of fluoride in community water supplies to one part per million, mottling could be reduced or eliminated and yet the caries rate was much reduced. This classic work led to the widespread fluoridation of community water supplies throughout the United States.\textsuperscript{29}

**Equipment and Devices**

There is evidence that the Maya and other ancient cultures used primitive "bow drills" and other devices to prepare round ornamental cavities in teeth. Some early attempts at filling teeth are also in evidence.

By the nineteenth century, hand drills with steel bur heads were used by twirling the long handles with the fingers. Later, a "bur thimble" was used. Some drills were made bendable by attaching flexible shanks between the bur heads and the handles, allowing the more posterior portions of the mouth to be accessed. In addition, many mechanical devices were introduced, notably the Lewis drill from 1838, Chevalier's "drill stock" from the 1850s or earlier, and Merry's drill of about 1858.

In 1871, Morrison introduced his foot treadle dental
engine. This was the first practical foot operated dental engine to be used in dentistry, although John Greenwood made the first dental foot engine in 1790. Shortly after this, dental handpieces were developed to accept hand-made steel drills. This represented the first significant increase in rotational speed over the hand-operated hand-held drills.

A major innovation was the rubber dam, introduced by a New York dentist, Sanford Barnum, in 1864. This allowed for the dryness so crucial to the proper placement of cohesive gold foil restorations, developed a short time before. Barnum received accolades, including the bestowal of a medal, from the dental profession, for his gift of the rubber dam without the motive of financial remuneration.

In 1891, the S. S. White Company introduced the first machine-made steel burrs, known as Revelation Burs. Also, at about this time, corundum and crude diamond instruments were introduced to assist in the preparation efforts. In 1891, Acheson discovered a method for making an industrial abrasive composed of silicon carbide, which he patented in 1893 and named Carborundum. When the material was adapted to dentistry, it became a very important abrasive substance for reducing tooth structure and for dental laboratory work. At first, however, it was in short supply and did not become widely available in dentistry until later.

In 1867, Morrison introduced his first dental chair. This was a noteworthy device, incorporating a wide range of adjustments. In 1877, the first pump type hydraulic dental chair, the Wilkerson chair, was introduced. Dental chairs continued to evolve, designed mostly for stand-up dentistry, until some models were introduced that were geared toward sit-down dentistry. In 1954, a group of dentists, including Dr. Sanford S. Golden, met to develop a reclining chair for patients that would allow the dentist to sit while operating. The result of their efforts led to the introduction of the Ritter Euphorian Chair. Although this chair received an award for being the first dental chair exhibiting a major change in 50 years, it would not permit the patient to be fully reclined without his/her feet going up in the air. The introduction of the Dental-Ez chair, by John Naughton in 1958, was the event that ushered in the era of modern sit-down, four-handed dentistry. This chair had an articulated seat and back and became “accepted as the standard by the profession.”

Electricity was discovered in the late 1800s. The first electric drill, which was battery powered, was introduced the same year as the first foot pedal drill, in 1871. With the introduction of electrification to communities, electric dental drills began to be introduced, although slowly. Well after their introduction, however, foot-operated drills were still in widespread use. As an example, the University of Iowa’s new College of Dentistry building, opened in 1918, featured foot-operated drills. Nevertheless, by 1915, the electric dental engine was seriously competing with the foot treadle drill. Even so, these early electric dental drills were limited to rotational speeds of about 4,000 rpm. Modern diamond instruments were introduced in Europe in the 1930s and in the United States shortly thereafter. Their full potential was not to be realized until sometime later, however, when high-speed handpieces came into use.

The first commercially produced amalgamator was introduced in 1937. Prior to that time, amalgam was mixed in a mortar and pestle, a time consuming and unhygienic process.

A series of developments led to the use of high-speed instrumentation. Many of the handpieces are noteworthy, such as Norlen’s “Dentalair,” conceived in 1948, Walsh’s air turbine handpiece of 1949, Nelsen’s water turbine handpiece (1952) and Page’s belt-driven high-speed handpiece of 1953. It was in 1957, however, that a handpiece was introduced that revolutionized the practice of dentistry almost overnight. John Borden introduced his Sensational Airrotor handpiece, operated by air and allowing for rotational speeds of up to 200,000 rpm. The development of miniature ball bearings, in part, facilitated its development. It is from this design that all current air-operated high-speed handpieces have evolved. The carbide dental bur, introduced in 1947, now had a vehicle with which its full potential could be realized. And, the diamond rotary instruments could also be used with high efficiency.

Today, electric high-speed handpieces, under development for the past 40 years and in common use in Europe, rival and in some ways surpass the merits of air-driven high-speed handpieces. Their use in the United States has continued to increase. Some of their principal advantages are quietness of operation, great concentricity and very high torque, but these things are countered by their relatively high cost.

Many other devices have made dentistry more efficient and safe. Among these are sterile, disposable needles (1959) and precapsulated dental amalgam (1970).

Direct Restorative Materials

In the history of operative dentistry, direct restorative materials have principally included: lead, mastic, gold, tin, amalgam, fusible metal of Darcet, gutta percha, silicate cement, direct-filling methyl methacrylate resin, composite resin and glass ionomer cement.

In the first century AD, Celsus may have recommended lint, lead and other materials to fill cavities. Other early substances used to fill teeth included
alum, honey and ground mastic (a yellowish resin that comes from a small Mediterranean evergreen tree). It appears that gold leaf, in a non-cohesive form, has been used to fill teeth for over 500 years. Pierre Fauchard, wrote in the 1700s of the use of lead, tin and gold as filling materials, but he preferred tin.

August Taveau, of Paris, mixed shavings from French five-franc pieces with mercury in 1826. The resulting amalgam restorations, although inferior by today’s standards, permitted a means by which teeth could be saved in a relatively easy and inexpensive manner. The Crowe brothers introduced amalgam into the United States in 1853. Unfortunately, they used the material unscrupulously and gave it a bad name. Eventually, a major rift known as the “amalgam war” resulted, pitting amalgam advocates against opponents of amalgam. The controversy over the use of amalgam raged for most of the rest of the 1800s and many early operative dentistry textbook authors denigrated its use. In the late 1870s, an organized movement supporting the use of amalgam, to become known as the “new departure,” began. Ring states that amalgam was the predominant restorative material in the late 1880s. Nonetheless, during the 1890s, a great controversy still raged over the propriety of using amalgam. This “battle” pitted many highly-respected dentists against each other. Fortunately, the advocates finally prevailed and, after many years of experimentation, G. V. Black introduced a balanced amalgam formula in 1895. This formulation and its derivatives remained essentially unchanged until at least the 1960s and were responsible for the salvation of countless millions of teeth.

In 1963, Dr. William Youdelis, a Canadian metallurgist, developed high copper amalgam. This form of amalgam yielded enhanced long-term marginal integrity and is the major material in use today.

In the 1830s, a fusible alloy of lead, bismuth and tin, known as “Darcet’s metal” was used to fill teeth. This material was heated and then poured into the tooth in the molten state, after which it quickly hardened. Later, improvements were made to lower the melting point of the material. According to one source, it was used in France more than any other material between the years of about 1835 to 1845.

Until the latter part of the nineteenth century or the early part of the twentieth century, the use of tin for filling teeth was promoted by many. As a foil, its virtues were espoused through many publications. In fact, tin was considered by many to be second to gold as the most desirable direct filling material. The use of tin in combination with gold and other metals was also promoted as a means of more rapidly building up a restoration and enhancing the properties of tin.

Gutta percha was discovered in India in 1842. It was used as a filling material, although mostly as a temporary one, and in its early history was also used for the filling of root canals, sometimes mixed with chloroform.

Zinc oxychloride cement was introduced in 1869. It was used as a filling material, although it was not a very good one, and was also used as a cement. In 1879, zinc phosphate cement was introduced in dentistry. Zinc phosphate represented an improvement over zinc oxychloride and was also used as a filling material and as a cement. Today, zinc phosphate remains a highly respected cement, well over 100 years after its introduction.

There is good evidence that gold foil has been used to fill teeth for over 500 years. Until 1855, all such gold was non-cohesive and required substantial undercuts near the cavosurface areas of cavities in order to retain the restorations. The frustration frequently encountered with such use of direct gold led practitioners to try other restorative materials, such as crude amalgams and gutta percha in the early 1800s. A crystalline form of gold, known as “sponge gold,” was tried in the 1840s or 1850s. This gold was in a form somewhat like today’s mat gold. It was hard to handle and not much better than the plain sheets of gold foil in use previously.

However, in 1855, Robert Arthur discovered that by heating the gold foil, impurities could be driven off and the gold could be made to adhere to itself, a property known as cohesion. This was a major advance for dentistry.

In the succeeding years, direct gold changed very little, except for the introduction of mat gold and gold pellets, both of which enhanced the speed of compaction. The use of direct gold is no longer commonplace. Its high technique sensitivity, demanding regime and high placement time, along with the development of high quality composite resin materials has led to its disfavor. A small cadre of users still exists, however, and the material, when well placed is an extremely good one.

In 1908, silicate cement was introduced in the United States, although earlier, crude forms were used in Europe in the late 1800s. This was the first direct semi-esthetic filling material. Silicate cement had the advantage of high fluoride release but also was highly soluble in oral fluids. As a result, the longevity of restorations made from silicate cement was relatively poor. Silicate cement remained in widespread use into the 1960s and early 1970s, when composite resin replaced it as the primary direct esthetic filling material. In 1967, Gilmore stated that silicate cement “is the most commonly used anterior restorative material and for the most part has not been altered for three-quarters of a century.”
In 1947, direct-filling methyl methacrylate resins were introduced into the United States and came into general use by 1949. They were heralded by some as a significant improvement over silicate cements. These resins had low solubility, but their shrinkage and subsequent marginal leakage was high, often leading to significant interfacial staining.

In 1955, Dr. Michael Buonocore made a significant discovery that opened the way to a vast world of bonding of resins and cosmetic dentistry to unfold over the next fifty years. He found that by applying a solution of phosphoric acid to enamel, significant mechanical bonding of resins could be achieved.

After the introduction of composite resins, developed by Bowen in 1962, the use of silicate cements and acrylic resins decreased dramatically. In fact, within about two years after composite resins were introduced, the use of silicate cements and acrylic resins essentially came to an end.

A notable event in the evolution of composite resins was the introduction of ultraviolet light-curing around 1973, resulting in command-setting resins. With the UV system, fractured anterior teeth could be rebuilt quite esthetically and conveniently, unlike with the previous chemically-setting resins. These UV resins remained popular for a number of years, until the introduction of visible light-curing composite resins in about 1978. The visible light-curing resins offered the advantages of no UV hazards, faster setting times and better color stability.

The development of dentin bonding agents was another significant advancement. Many generations of such agents have existed, since their introduction in the late 1950s. The restoration of root surfaces with little or no enamel present is reliable with the currently-available agents.

Microfilled resins came into use around 1977, providing practitioners with highly-polishable and stain-resistant restorations when used in conjunction with the acid-etch technique. Hybrid and microhybrid resins, now in widespread usage, offer both high strength and relatively good polishability. Microfilled, hybrid and microhybrid resins are used extensively in cosmetic procedures, ranging from small Class III restorations to diastema closures, large Class IV restorations, and direct anterior veneers. In addition, composite resins have come into widespread use for the restoration of all classes of cavities in posterior teeth.

In the late 1960s and early 1970s, resin pit and fissure sealants were introduced and advocated for the prevention of caries in susceptible pits and fissures in children. These agents were accompanied by early skepticism within the profession. With time, and with the introduction of better materials, sealants gained acceptance and were found to be highly effective. The term preventive resin restoration is applied to the treatment of early carious lesions in pits and fissures, involving the removal of carious tooth structure and its restoration with composite resin, followed by the application of a sealant to cover all remaining pits and fissures. Such practice has become widespread and has been responsible for the adoption of very conservative restorative procedures that generally weaken teeth less than when amalgam is used.

Glass ionomer cements were invented in 1968 and first described by Wilson and Kent in 1971. Like silicates, these restorative materials exhibited the property of high fluoride release. However, unlike the silicates, the glass ionomer cements showed low solubility. Glass ionomer cements have been widely adopted by the profession and currently have extensive applications.

Indirect Restorative Materials

Indirect restorations have generally been fabricated from impressions taken of prepared teeth. The earliest impression material was probably beeswax. A reference to the use of wax for dental impressions was made in 1684 by a German surgeon. Wax was a poor impression material by today’s standards, but it functioned adequately in its day by being capable of removal over undercuts.

Gutta percha, obtained from certain trees in Malaysia, may have been introduced as an impression material in 1848, but it was not very satisfactory for that purpose.

The first use of plaster of Paris, so named because one of the most extensive deposits was found in the “Paris Basin,” near Paris, France, is uncertain. One source traces its introduction to the dental profession to about 1844 whereas another traces its roots to the very early 1800s. John Greenwood attested to his first use of plaster of Paris in 1826. Plaster was apparently used for developing (“pouring up”) dental impressions before it was used as an impression material. Plaster was an accurate impression material, but had the significant disadvantage of being inflexible. It typically fractured upon its removal but, when reassembled, could produce an excellent impression. Plaster of Paris was the most commonly used impression material in 1904.

Charles Stent developed modeling compound in England in 1857. This modeling compound was an attempt to improve gutta percha by adding stearine, a substance made from animal fat, to improve plasticity and stability, and talc, used as an inert filler to strengthen and “add to the texture” of the material, and a red coloration. This became a common material to use for making impressions. Copper bands or other devices were used in the late 1800s, along
with impression compound, to make impressions for full crowns. Then, tin was swaged onto a die and solder was melted to form the occlusal surfaces. In a similar manner, inlays and onlays of gold could be fabricated. A major textbook of 1932 described the construction of gold inlays by the indirect method, utilizing impression compound extensively for impression making. Over the years, the formulation of impression compound has been enhanced and it is still in common use in clinical dentistry.

Reversible hydrocolloid was introduced to the dental profession in 1925 by Alphonse Poller, an Austrian. The material was patented as “Nogacoll.” In 1931, the material was also sold under the name of “Denticol.” The material was first used for making impressions of human faces to fabricate plaster reproductions, but was soon adapted to dentistry. By 1935, almost a dozen competing brands were in use. The fundamental ingredient of hydrocolloid is agar-agar, a colloid obtained from seaweed. Prior to the development of hydrocolloid, only wax, gutta percha, modeling compound and plaster of Paris were available to the dental profession for purposes of obtaining impressions of any kind. Now, a flexible material was offered that could spring over undercuts and recover and be used to produce an accurate model. These agar-type reversible hydrocolloids were probably used only for removable partial denture impression work prior to about 1935, when A. W. Sears promoted the material for use in fixed partial denture impression making.

During the World War II era, or just before, irreversible hydrocolloids were developed and they were introduced to the dental profession in 1943. Agar-agar had become scarce, since most of it came from Japan. Like their reversible counterparts irreversible hydrocolloids, known as alginites, were developed from seaweed and were salts of alginic acid, such as sodium alginate.

Until the introduction of polysulfide impression materials in 1953, the hydrocolloids were the only elastomeric impression materials available to the practices of operative dentistry and prosthodontics. The new elastomeric polysulfides, although messy and relatively sensitive to distortion, offered much more strength than the hydrocolloid material and soon became very popular.

As elastomeric impression materials evolved, the polysulfides gave way to more stable, less messy materials such as the polyethers (late 1960s), the condensation silicone materials and the polyvinyl silicone (addition silicone) materials (1970s) that are now in widespread use.

Porcelain inlays were described at least as early as 1857. Enamel was also ground to form rather crude inlays for cementation into cavities in teeth. Porcelain inlays played a significant role in the restoration of teeth in the last part of the nineteenth and early part of the twentieth centuries judging by the large number of publications devoted to techniques for their fabrication and placement. This is only a sampling of the hundreds of references to the porcelain inlay to be found in this era. In the period from 1900 to 1910, there was a particularly large number of articles published on porcelain inlays, whereas after 1915 the number was vastly reduced. It is probable that the recent introduction of the cast gold inlay and silicate cements were responsible for the diminished interest in the porcelain inlay. The first silicate cement, zinc phosphate cement, was introduced in 1879. Over the years, a wide variety of other cements have been introduced. Even so, zinc phosphate cement remains one of the tried and tested cements still in widespread use.

There is good evidence that metal casting, utilizing the lost wax or “cire perdue” method, has been utilized since ancient times. In 1844, a French dentist, Aguilhon de Saran, reportedly formed an investment mold from an impression of a cavity and melted gold into it to produce an inlay. In the latter half of the nineteenth century, many techniques were described for the fabrication of gold inlays, most of them involving the procedure of flowing solder into molds made of tooth cavities. Although the art of casting as we now know it had not been yet described, a wide variety of sophisticated crowns and bridges had already been described by the late 1880s. One of the greatest achievements in restorative dentistry occurred with the introduction, by William Taggart, in 1907, of his method of making gold castings. The systems somewhat paralleling his were advocated and used in the 1890s or before. Although systems somewhat paralleling his were advocated and used in the 1890s or before. In 2000, the Cerec 3rd was introduced. This latest system provides a means by which a sophisticated ceramic inlay or onlay can be fabricated, with a hand-held scanner reading the details of the preparation and software subsequently being used to drive the mechanism to precision mill (grind) a restoration.
without the use of an impression and without the need for a second dental appointment.

Illumination and Magnification

In the early days of dentistry, only natural light was available. The first artificial dental light was probably a candle. In the latter part of the nineteenth century, dentists used kerosene lamps with focusing devices to direct light into patients' mouths. After the introduction of electricity, large ball-like ceiling fixtures were used in operatories. In the first decade of the twentieth century, the first patient lights were introduced. These were lights that could be focused directly into the mouth. With the introduction of lights such as the Castle Pano Vision® in the 1950s, high illumination was finally realized, permitting the dentist to visualize the oral cavity to a more significant degree. Mouth mirrors were introduced in the 1800s, but it wasn't until 1950 that front surface mirrors were advocated, and later came into widespread use. Now, clear images without the double image of the glass-covered mirrors formerly in use, were possible.

Miner-type headlamps were used by dentists, often oral surgeons, in the 1950s, but by the 1990s, vastly improved, small headlamps were available to dentists so that any operative dentist could utilize enhanced intraoral illumination.

The use of magnification in dentistry is not new, with references to it found at least as long ago as the nineteenth century. In 1866, Atkinson published on the merits of intraoral magnification. In 1873, Parsons recommended the use of a large two to three inch diameter magnifying lens, with a handle, to examine teeth intraorally for gold margins, fissures and cracks.

The magnification in use by the 1930s consisted of rather crude devices, and later plastic "loupes" were clipped onto eyeglass frames or attached to headbands. By the 1980s, high-quality ground glass optical telescopes were available to the dental profession. Today, a significant number of practitioners, including ever-increasing numbers of dental students, avail themselves of these significant improvements to vision. As a secondary benefit the use of telescopes allows dentists to maintain improved posture.

Summary

Many notable events in the development of the art and science of operative dentistry have been presented. Not only has "necessity been the mother of invention," but many individuals have shown independent brilliance in their innovations and fabrications. Operative dentistry continues to grow and become enriched as the most recent developments become refined. It is especially the current age of cosmetic dentistry that has been a real boon for the public and the profession. It has spurred the development of many new techniques and materials and made a wide variety of cosmetic procedures available to vast numbers of patients. No doubt, the field of operative dentistry will continue to evolve and change just as it has for so long in the past.

Chronology of Events

1826 Use of filings of French five-franc pieces mixed with mercury by August Taveau, of Paris
1833 Introduction of amalgam into the United States by the unscrupulous Crawcour brothers from France
1844 Plaster of Paris introduced, by this date, for impressions of teeth
1855 Cohesive gold foil is discovered by Robert Arthur
1857 Charles Stent develops impression (modeling) compound
1857 Description of the porcelain inlay
1864 Rubber dam introduced by Sanford Barnum
1865 Pasteur described putrefaction and transmission of microorganisms, leading to the "germ theory"
1867 Antiseptic Era inaugurated by Joseph Lister
1867 Introduction of the Morrison dental chair
1871 Morrison foot-treadle dental engine introduced
1879 Koch identified the microorganisms causing wound infection
1879 Zinc phosphate cements introduced
1884 Conduction anesthesia demonstrated by William S. Halsted using cocaine
1890 Publication of the chemico-bacterial cause of dental caries by Willoughby D. Miller, an American dentist
1891 Introduction of the first machine-made steel bur, the S.S. White Revelation Bur
1891 Scientific cavity preparation described by G. V. Black
1893 Modern system of dental nomenclature presented by G. V. Black
Chronology of Events (continued)

1893  Process for making Carborundum® (silicon carbide) patented
1895  “Balanced” formulation for dental amalgam proposed by G.V. Black
1895  Discovery of X-rays by Wilhelm Conrad Röntgen
1896  C. Edmund Kells adapted X-rays to dentistry
1800s  Introduction of dental assistants late in the century
1905  Discovery of Procaine (Novocaine®) by Einhorn and Uhfelder
1906  Introduction of dental hygienists into the dental office
1907  Cast gold process described by William Taggart
1908  Silicate dental cement introduced
1915  Electric dental engine becoming widespread in use
1925  Reversible hydrocolloid impression materials introduced
1934  Introduction of modern diamond instruments
1937  Introduction of the Wig-L-Bug®, the first commercially produced amalgamator
1941  Irreversible hydrocolloid impression materials (alginites) developed
1942  Recognition of the caries preventive property of fluoride in concentrations of 1 part per million in drinking water
1947  Carbide dental burs introduced
1947  Direct methylmethacrylate filling materials introduced in the United States
1950  Introduction of the front surface mirror (Lidocaine), discovered in 1943, by the dental profession
1953  Introduction of polysulfide elastomeric impression materials
1955  Acid etching of enamel described by Michael J. Buonocore
1957  Borden Airator introduced
1958  Modern reclining dental chair developed by Naughton
1950s  Dentin bonding agents introduced late in this decade
1962  Composite resins described by Rafael Bowen
1963  High copper amalgam alloys developed
1960s  Introduction of pit and fissure sealants
1968  Glass ionomer cement invented
1970  Ultraviolet light-curing composite resins developed
1977  Introduction of microfilled composites
1978  Visible light-curing composite resins introduced
1982  Introduction of high quality high magnification loupes (telescopes) in dentistry
1985  Cerec® ceramic inlay system introduced
1990  Use of modern high-speed electric dental handpieces
1990  Operator headlamp lighting widely available
1990s  Adoption of advanced dentin bonding agents
References

57. Crawford F. R. The story of silver amalgam (and how a
Canadian changed it all!!). J Canadian Dent Assoc 1989; 55 (11) 887-90.
95. Cheeseman F.E. A plea for a return to the use of the porcelain inlay. Items of Interest 1911; 33 (11): 853-68.
96. Stryker L.W. The practical manual of dental casting, being the recorded experiences of many able and eminent men in the dental profession. 2d ed. Toledo, OH, Ransom & Randolph Co., 1913.
104. Atkinson W. H. Glasses in dental operations. Dent Cosmos 1866; 8 (5); 456-60.