THE LEGENDS OF IMPLANT DENTISTRY

with the History of Transplantology and Implantology

Leonard I Linkow



Foreword

Ole Krogsgaard Jensen

JAYPEE

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The Great Pioneers of Implant Dentistry

WHY DENTURES DON'T REPLACE NATURAL TEETH

My dentures are uneasy in the mouth
– George Washington
Letter to his dentist

*Ill-fitting denture appliances **may** impair your health*
– Council on Dental Therapeutics
American Dental Association

If you are embarrassed to open your mouth because of ill-fitting dentures or missing teeth, you are not alone. The American Dental Association has reported that more than 23½ million Americans have lost all of their teeth. That's about 7.5% of the population of the United States. In fact, that's nearly 75% of the population of Canada!

You have plenty of company throughout history, too, Archeologists have found evidence of dental disease and tooth loss among all ancient and prehistoric people. Tooth decay has been found in Neanderthal remains. And one Egyptian mummy was diagnosed as having suffered from gum disease and abcesses as well as tooth decay.

Dentistry was a recognized profession in Egypt as far back as 3000 BC. The first dentist of significant historical record was an Egyptian named Hesi-Re.

At that time, Egyptian dentistry was probably the most advanced in the world, and even then dentists performed surgery to try to save diseased teeth. They also prescribed various powders to relieve toothache. But, try as they may have, their methods could not always cure the ailing tooth. In fact, a major responsibility of ancient dentists seems to have been the pulling of decayed and aching teeth. Thus arose the need for artificial replacements.

DENTURES: THE ANCIENT WAY

It is hard to document exactly how much anatomical knowledge the ancients had. Perhaps they knew, as we do, that toothlessness impairs the health of the gums and weakens the remaining teeth—if any. They must certainly have been aware that the condition makes eating difficult. They also knew that toothlessness was unattractive; the Talmud tells of a woman who got an artificial tooth in order to please her fianci. We do know that in those times, as in our own, there was a demand for artificial teeth to replace missing real ones.

Ancient people used a variety of materials for false teeth. Some of the earliest ones were animal teeth, whittled down to human proportions if necessary. Later on, false teeth were carved from ivory or the bones of various animals. Gold and silver were also used, as was, less expensively, wood.

Artificial teeth at that time weren't set into a base as today's dentures are. Instead, they were attached to the remaining natural teeth with gold or silver wires. The false teeth might have been riveted to a gold or silver band, the ends of which were then slipped over the neighboring natural teeth.

This kind of denture must have been popular in ancient Rome—or else Roman denture wearers were skilled at lobbying—for a Roman law passed in 450 BC forbade the burial of dead with their jewelry, but made an exception for the gold or silver appliances used to maintain false teeth.

The Romans would have done better to worry about retaining their natural teeth while they were still alive. Ancient dentures were rather unsteady, and not very efficient for biting or chewing. The bands also imposed a strain on the natural teeth that supported them—and, to modern eyes anyway, the metallic appliances were unsightly.

The Etruscans devised various ways to implant gold wires, mesh and root forms for replacement teeth.

JAYPEE BROTHERS



Fig. 1: L'arracheur de dents. Gérard van Honthorst (1590-1656). Musee du Louvre, Paris. Mistoire Illustrtée De L'Art Dentaire-Michel Dechaume and Pierre Huard-Les Editions Roger Dacosta, Paris, 1977

Probably the first person credited with a written paper of transplants as a means of replacing teeth was the Arabian surgeon, Albucasis de Condue (936-1013). He also included the use of implants made from oxbone. Albucasis de Condue stated that when a maxilla was broken, and its teeth came out of their sockets, it is necessary to place them back into their original sites and keep them there by means of small bamboo rings intertwined by gold and silk threads. Together with the previously reported Mayans, this is the oldest record of dental transplants. (It might well have been an ancient practice, even though archeological remains, graves, necropolises and sarcophagi, have not revealed anything really substantial). But, even without reverting that far back in history and to so distant countries, in Abulcasiz di Zabra's "chirurgia" (Cordova 1106-1112) we read that "pullen teeth replaced and tied can be kept in place, or else teeth can be made from cow's bone."

During the next several centuries barber-surgeons in England and continental Europe became responsible for tooth transplantations operations.

An early investigator of tooth transplants was the Frenchman, Ambroise Parefin 1530. He stated "I had it reported by a credible person that he saw a lady of the prime nobility, who instead of rotten tooth she drew, made a sound tooth drawn from one of her waiting maids at the same time to be substituted and inserted which tooth in process of time as it were taking root grew so firm, as that she could chew upon it as well as any of the rest."

What's more, dentures made from animal teeth were prone to decay. Even hippopotamus teeth, which were among the best of the material used, tended to turn black and smelly within a relatively short time-usually, less than two years.

DENTURES: THE MEDIEVAL WAY

In spite of the numerous shortcomings, animal teeth were still the best substitutes : available, and their use persisted throughout the Middle Ages. There was no shortage of customers for these false teeth, because at that time treatment of diseased teeth was primitive—often more primitive than it had been in ancient times. A person with a toothache frequently had no choice but to have the tooth pulled—if he or she was brave enough. The patient had to be brave, because in medieval Europe extractions were done—without benefit of anesthesia-by barbers, blacksmiths, and even wandering street performers. The latter made an audience-participation show out of the event. Some of the medieval "dentists" learned their trade through apprenticeship, and many seem to have possessed a good deal of common sense and manipulative skill.

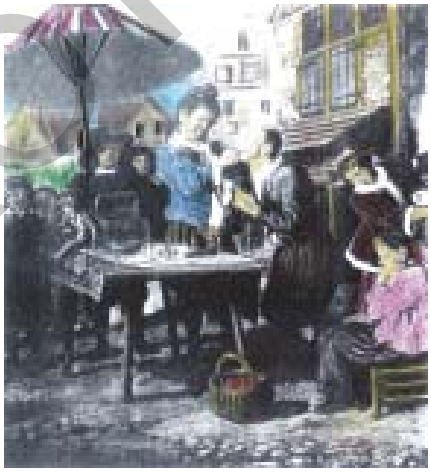
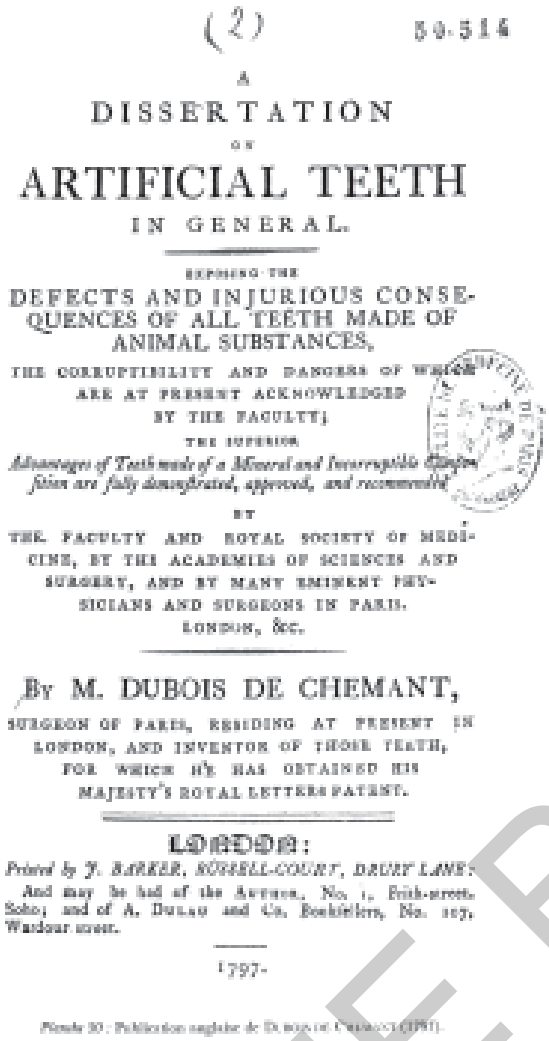


Fig. 2: Scene d'avulsion dentaire au XVII siècle par Jan Victors: Musée Dentaire de Coloma



Fig. 3: Another poor patient having a rotten tooth extracted by A Wandering street performer

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A

DISSERTATION

ON

ARTIFICIAL TEETH

IN GENERAL.

EXPOSING THE

DEFECTS AND INJURIOUS CONSEQUENCES OF ALL TEETH MADE OF ANIMAL SUBSTANCES,

THE CORRUPTIBILITY AND DANGERS OF WHICH ARE AT PRESENT ACKNOWLEDGED BY THE FACULTY;

THE SUPERIOR

Advantages of Teeth made of a Mineral and Incorruptible Kingdom Substance are fully demonstrated, approved, and recommended

BY

THE FACULTY AND ROYAL SOCIETY OF MEDICINE, BY THE ACADEMIES OF SCIENCES AND SURGERY, AND BY MANY EMINENT PHYSICIANS AND SURGEONS IN PARIS, LONDON, &c.

By M. DUBOIS DE CHEMANT,

SURGEON OF PARIS, RESIDING AT PRESENT IN LONDON, AND INVENTOR OF THOSE TEETH, FOR WHICH HE HAS OBTAINED HIS MAJESTY'S ROYAL LETTERS PATENT.

LONDON:

Printed by J. BARKER, RUSSELL-COURT, DRURY LANE;

And may be had of the Author, No. 1, Frith-street, Soho; and of A. Dulau and Co. Booksellers, No. 107, Wardour street.

1797.



Fig. 4: Le Charlatan. Jan Steen (1626-1679) Rijksmuseum, Amsterdam



Fig. 5: Le dentiste ambulant. Pietro Longhi (1702-1785) Milan. Histofre IllustrCe De L'Art Dentaire - Michel Dechaume and Pierre Huard - Les Editions Roger Dacosta, Paris, 1977



Fig. 6: Giovanni Michele Grancri, Der Zahnnbrecker 01 auf Leinward, Museo Givico, Turin Die Zahnheilkunde in Kunst-uns Kulturgeschichte Heniz E. Liissig und Rainer A. Miiller Dumont Buchverlag Koln 1983. In medieval Europe Extraction were done by barbers blacksmiths and even wandering street performers.



Fig. 7: Jan Victors. Ein Zahnziecker, 1654. 0l Auf Leinward Historicich Museum, Amsterdam Die Zahnheilkunde in Kunstund Kulturgeschichte Heniz E. B s i g und Rainer A. Miiller Dumont Buchverlag Köln 1983

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Fig. 8: A beautiful rendering done by a famous Russian artist, Yuri Pugaciov, showing an 18th century setting with Dr. Linkow holding up General Washington's wooden denture. The painting also shows the face's of Dr. Linkow's staff dressed in 18th century garb

GEORGE WASHINGTON HAD PROBLEMS, TOO

Over the centuries, dental care gradually improved. One improvement was in the area of oral hygiene. The Chinese invented the modern toothbrush in 1498, and by the 17th century Europeans had begun to use it. Previously, they had cleansed their teeth with their fingers or with toothpicks, twigs, and sponges; instead of toothpastes, various natural substances and mixtures were used as dentifrices.



Fig. 9

Scientific knowledge also increased. More became known about teeth and the anatomy of the mouth and jaw. The French were in the vanguard of this new interest in science, and a French dentist, Pierre Fauchard (1678-1761)' is credited with having raised dentistry to the professionalism it hadn't merited since ancient times.

By the time of the American Revolution, trained dentists from France and England had arrived in America. Apparently they were badly needed, for visitors of that period often commented on the terrible state of the inhabitants' teeth. At the time, writers attributed these



Fig. 10: THE TOWN TOOTH DRAWER
Der Stadt Zahnarzt Aus der Gleichen Serie wie Abb. 325, Gedruekt und herausgegeben von W. Davidson Alnwick
Die Zahnheilkunde in Kunst-uns Kulturgeschichte
Heniz E. Lassig und Rainer A. Miiller Dumont Buchverlag Koln 1983



Fig. 11: THE COUNTRY TOOTH DRAWER
(Printed and Published by W Davision Alnwick)
Il Pudore Della Bocca - Editoriale Belisario - Milano, 1975
Sctne d'avulsion dentaire au XVII Sitcle Par Jan Victors.
Musee Dentaire de Cologne
Der Land Zahnarzt Radierungeines Unbekannten England.
Ende 18 Jh. Wellcome Institute, London

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dental calamities to the violent extremes of the temperatures on this continent, as well as to other causes.

Some of the Europeans taught Americans the skills of dentistry. One student was apparently Paul Revere, who learned to make and repair false teeth. I'll bet you didn't know that Revere numbered dentistry among his many talents, but he did. He advertised in the **Boston Gazette** on September 19,1768, "All persons who have had false teeth ...and they have got loose (as they will in Time) may have them fastened by the above"-that is, Revere.

The false teeth themselves, however, were almost as primitive as they had been in the time of the Caesars. George Washington consulted many dentists, and yet his dentures were notoriously unattractive and are rumored to be the reason he was always pictured with his mouth shut. We know for sure that Washington was distressed not only by the uncomfortable feeling of his dentures but also by the way in which they changed his appearance. In a note to one of his dentists, he complained that the artificial teeth "bulge my lips out in such a manner as to make them appear considerably swelled."



Fig. 12: Acaza de dientes (à la chasse qus dents) Fr Goya (1746-1828) Entre 1793 et 1797 A young woman shaking of fear hiding her face with her left hand holding handkerchief while trying to pull a tooth from the hanged man

Washington owned several sets of false teeth. They were made of various kinds of ivory (not wood). The New York Academy of Medicine possesses a denture for the lower jaw that bears this inscription: 'This was Great Washington's teeth." It is dated 1789, and signed by John Greenwood, Washington's favorite dentist. The denture consists of human teeth set in an ivory base.

We don't know from whose mouth the teeth in Washington's denture came, but it is a fact that human teeth were often used in dentures in this period. The teeth might have been extracted from the patient's own mouth; or a rich person might pay a poorer one for the use of his or her teeth, in much the same way blood may be paid for today. Just as hospitals today maintain blood banks,

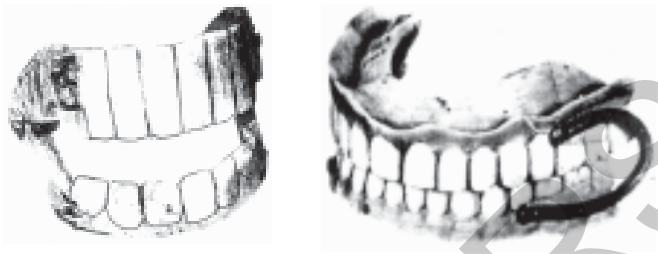


Fig. 13: These dentures, although similar, did not belong to George Washington. Il Pudore Della Bocca-Editoriale Belisario-Milano, 1975

some dentists of that time maintained "banks" of teeth that they had extracted or bought.

Teeth were also taken from dead people's mouths. Sometimes 18th obtained in that way were used for witchcraft rather than for dentistry. Hanged men's teeth were believed to have specially magical properties, and an aquatint done by the Spanish artist Francisco Goya in the 1790s shows a woman trying to extract teeth for this purpose from a corpse that's still on the gallows (Goya was against the practice).

I don't know whether human teeth are still in demand for witchcraft, but the danger of infection gradually made their use in dentures unpopular.

The ivory base of Washington's dentures was another standard feature of 18th century dental work. When only a few teeth were missing from the patient's mouth, dentists of that period would fit crowns onto healthy teeth to serve as supports for a denture holding one or



Fig. 14

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Fig. 15: Dankbrief George Washingtons an seinen Zahnarzt John Greenwood. 1795. Baltimore College of Dental Surgery, Baltimore. George Washingtons Lower Denture Unterkieferprothese von George Washington, gefertigt aus einem Nilpferdzahn mit aufgesetzten natiirlichen Zahnen. The New York Academy of Medicine, New York



Fig. 16: Washingtons Maxillary Denture Oberkieferprothese aus Effenbein Anfang 19Jh

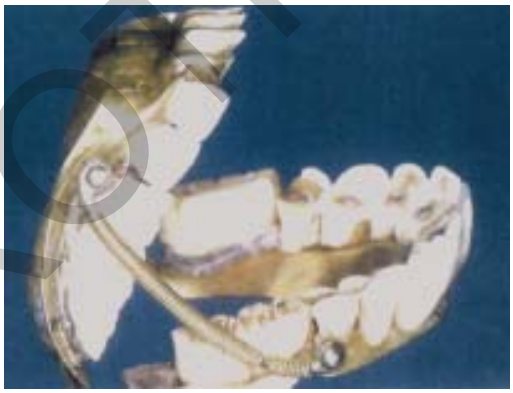


Fig. 17: Unterkiefer und Oberkieferprothese mit Goldfern Dental plates with springs were very similar to George Washington's teeth. Die Zahnheilkunde in Kunst-und Kulturgeschichte Heniz E. Lässig und Rainer A. Miiller Dumont Buchverlag Köln 1983

more artificial teeth. This kind of appliance is the forerunner of our modern bridge, and it is just as stressful for the natural teeth which act as anchors. For the toothless or almost toothless person, George Washington included, dentists of the time fitted the artificial teeth into bases of ivory or metal. Sometimes the metal used was lead, which we now know is potentially poisonous to the wearer.

Like modern denture wearers, the patient of Washington's era was faced with the problem of loose dentures. Previously this had been less bothersome, for complete dentures had been attached to the jaws by wires, which were unsightly—how would you like to walk around with your dentures tied behind your ears—but relatively secure. Then, wishing to make a self-sustaining appliance, dentists began making slip-in dentures in one piece. They joined the upper and lower halves with splints and springs.

Washington's dentures were joined by springs, and he found it difficult to keep them in place, especially when talking or eating. It must have been difficult to maintain his presidential dignity while trying to keep his dentures from suddenly "springing" out of his mouth. Such dentures were also noisy, easily broken, and they caused painful pressure on both jaws.

During those "Washington" years, a Dr King developed an upper and lower denture held together by a very unique round rigid wire that was fashioned to lock into a channel made in the lower right and lower left molar as well as transverse through horizontal holes made in both maxillary lateral incisors below their pulp chamber. In this manner, the right wire acted as a spring keeping both dentures together. Dr King did his own marketing, as can be seen by his $5.00 fee for a full set of dentures.

Modern dentures don't have springs, but they share many disadvantages.

THE NINETEETH CENTURY: MODERN DENTURES MAKE THEIR DEBUT

The nineteeth century saw the introduction of denture materials and techniques that are, with some modifications, still in use today.

Porcelain teeth became well known in the United States in the early nineteenth century. They had been invented earlier by Alexis Duchateau, who, one day in 1774, decided that he had had it with his stained and foul smelling hippopotamus dentures. (They probably smelled because

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Fig. 18: These were George Washington's teeth by Dr John Greenwood, fabricated in 1789



Fig. 19: Greogre Washingtons Lower Denture, Il Pudore Della Bocca—Editoriale Belisario-Milano, 1975

they were decaying, and stained, because he was in the habit of tasting the chemicals he stocked in his drugstore). Duchateau reasoned that since dishes could withstand food stains and did not decay, teeth should be made of a similar material. So he went to a porcelain manufacturer and had a set of teeth fabricated.

The first set was a failure; the dentures shrank during the manufacturing process. Eventually, though, Duchateau produced a set that he could wear. He tried to make porcelain teeth for other people as well, but, since he wasn't a dentist, he could not fit them properly.

So along came Nicholas Dubrois de Chemant, a dentist who improved upon and popularized the process. For people who had had to wear dentures made of animal teeth or ivory, the new porcelain teeth were a real godsend, and de Chemant became a hero. One of his patients, a count, wrote a poem in his honor. It ended with these words: "Long live Chemant, our friend in need!"

During the French Revolution, de Chemant moved to England, where he became a popular dentist to British society.

The next major improvement came in 1800, when James Gardette, an American dentist from Philadelphia, accidentally found that dentures could be held in the mouth by suction alone. After all those centuries, it was finally discovered that no springs or wires were necessary to hold the dentures in place! Thus, George Washington's teeth became obsolete.

The first two-piece dentures were set in a metal base. Then, in 1839, Charles Goodyear, an American, discovered how to harden rubber by adding sulphur to it; he called the process "Vulcanization," after Vulcan, the Roman god of fire. In 1855, Goodyear's son, Charles Jr., patented a process for making dentures on a vulcanized rubber base. Vulcanized rubber became the mostly used material for denture bases and remained so until the introduction of modern synthetic materials.

DENTURE MATERIALS

Artificial teeth today are probably made of porcelain, which is still the most widely used material for dentures. Since the 1930s various kinds of plastics have also been used and today many denture wearers have the most advanced types of these plastic teeth.

The first plastic dentures became discolored and wore out quickly. An improved type of plastic, acrylic resin, is used today. While not as strong or long-lasting as porcelain, its lighter weight gives it an advantage in certain circumstances. For example, an acrylic resin plate is better suited than porcelain to withstand the forces of gravity in the upper jaw, and less likely to wear down any gold crowns in the opposite jaw.

Base plates—those uncomfortable things that your artificial teeth are attached to-come in a wider variety of materials these days, including processed acrylic resin, nylon, and polyamides. Base plates often have an inner core of material—perhaps gold, chromium cobalt alloy, or chromium-plated nickel alloy. A semi-liquid silicone "liner" is frequently inserted into the base; this is presumed to make the denture fit better and feel more comfortable.

One probably notices all the modern paraphernalia the dentist uses when dentures are fitted today. Dentists have X-ray machines to reveal the underlying structure of the patient's jaw; they have special equipment to take casts of the jaw in order to fit the false teeth precisely; and they have apparatus to test the way the dentures will move.

Yet when they have finished using all this fancy equipment, what have they accomplished? An artificial appliance that sits on top of your gums, just as the ancient Greeks and Romans had.

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HISTORY OF DENTAL IMPLANTS

The history of Implantology may be divided into three eras:

I. Ancient History 2000 BC to 1800 AD
II. Early History 1800 to 1940
III. Current History 1940 to present day (2009)
IV. Implants, as a treatment modality, are categorized as:
    1. Subperiosteal Implants:
        — mandibular and maxillary
        — tripodal
        — unilateral, universal and full arch
    2. Endosseous root form implants
    3. Endosseous blade/plate form implants
    4. Ramus blade and Ramus frame implants
    5. Transosseous - staple implants
    6. Mucosal inserts
    7. Endodontic stabilizers and pin (needle) implants
    8. Bone grafting and barrier procedures

The "new school" of dentists seem to believe that implant dentistry started with Branemark at Noblephama in the 1980s. A review of the literature, however, tells a different story. We will see that implants in dentistry did not just accidentally happen like many inventions or discoveries, but evolved slowly during a time span of decades, centuries and thousands of years. The greatest studies in the field of oral implantology have been accomplished in the last five decades.

DENTAL IMPLANT HISTORY- 2000 BC - 1800 AD

Ancient Egyptians, Greeks, Etruscans, Romans, Chinese, Indians and more recently, Arabs used tooth transplantation procedures. There are reports from archeological findings that man attempted transplanting teeth and implanting alloplastic materials in Egypt, as early as 2000 B.C.E. Perhaps, even prior to that, the very early Chinese emperors Chin Nong arad PTuang-Ti (both circa **27th** century BCE), as related by Darby in his published work in 1863, had gathered all the medical treatments that enjoyed great favor during their time, such as acupuncture, gold and silver needles, selection of areas and dental transplants.

Notably, many of these ancient practitioners used allogenic transplanted teeth taken from the poor or slaves and reimplanted them into wealthier patients for a fee given to the tooth seller as well as the "implanter" Various animal teeth were later used, such as sheep, goats, dogs, and baboons. They also used carved ivory and precious metals for the first dental implants.

A pre-Columbian skull at the Peabody Museum at Harvard University shows a carved stone implanted into the lower jaw. Indian relics were found with transplants of gold and jade inserts. In a museum in Peru, there exists a skull with 32 individual quartz and amethyst teeth implants dated ***800*** AD, over 1200 years ago Figs. 25, 27, 28.



Fig. 20



Fig. 21: Gold or silver bands held the false teeth and were attached to the remaining natural teeth by circling them (Introduced by the Etruscans)



Figs 22 and 23: In early times teeth would be extracted from the mouths of servants for a fee and re-implanted into the mouth of rich people

The Etruscans, the antecedents to the Romans, devised various ways to implant gold wires, mesh and root forms for replacement teeth.

Probably the first person credited with a written paper of transplants as a means of replacing teeth was the Arabian surgeon, Albucasis de Condue (936-1013). He also included the use of implants made from oxbone.

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An early investigator of tooth transplants was the Frenchman, Ambroise Parefin 1530. He stated, "I had it reported by a credible person that he saw a lady of the prime nobility, who instead of rotten tooth she drew, placed a sound tooth drawn from one of her waiting maids at the same time to be substituted and inserted and the tooth in process in time grew so firm that she could chew upon it as well as any of the rest."

Tooth re-implantations gained some popularity with varying degrees of success in the mid-16th century.

However, the Englishman, Charles Allen, did not agree with the concept of the "haves; getting teeth from the "have-nots." In 1687, Allen said, "taking out the rotten teeth or stumps and putting in their places some sound ones drawn immediately out of some poor bodies, head—I do not like that method—it is only robbing Peter to pay Paul."

Allen was not against transplantation of teeth; he only objected to the method at that time. He considered a better and more profitable method to be xenogenic tooth transplants: transplanting the teeth of "Brutes" such as sheep, goats, dogs and baboons to human jaws.

A French dentist, Pierre Fauchard, the father of dentistry, in **1728** showed for the first time a protocol for reimplantations of teeth that required the recipient be young in age with healthy gingivae and that the transplant be completed as quickly as possible.

Other 18th century pioneers included Bourdet, in **1768.** The foremost proponent of tooth transplantation was the Englishman, John Hunter. In 1778, he discussed tooth transplantation in his book on teeth. He remarked, "Success of this operation is founded on the desposition of all living substances to unite when brought in contact with one another although they are of different structure and even though the circulation is carried on in one of them. In a like manner a fresh tooth, when transplanted from one socket to another, becomes to all appearances, a part of that body to which it is now attached as much of the one from which it was taken; while a tooth which has been extracted from some time so as to lose the whole of its life will never become **firm** or fixed." Hunter disagreed with Fauchard over the use of teeth that had been extracted a long time previously. Fauchard reported transplants that lasted a year, and Hunter, of four years. At that time, however, nothing was known about immunology, and the failure of transplants was attributed to poor mechanics and techniques. The process, of course, awaited the later development of tooth implant materials. Fauchard and Hunter all believed the main cause of failure was related to the lack of conformity of tooth to socket.

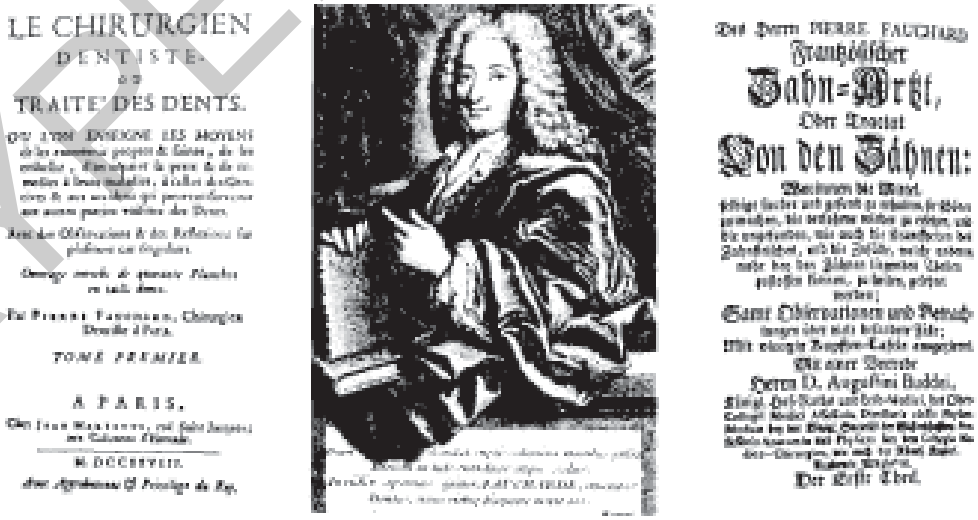

LE CHIRURGIEN
DENTISTE.
OU
TRAITE' DES DENTS.
A PARIS,
Der Berühmte Herr FAUCHARD
Französischer
Zahn-Arzt,
Oder Tractat
Von den Zähnen:
Herrn D. Augustini Buddei,
Der Erste Theil.

Fig. 24

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As just reported, varying degrees of success range from one year (Fauchard) to four years (Hunter) and amazingly, 10-16 years (Pfaff and Taft).

The Englishmen, Thomas Berdmore, in **1768** discussed transplantation as an expensive procedure. He said "'Transplantation is also immoderately expensive, for it is not to be The Great Pioneers supposed that any young person will sell a handsome tooth, to be torn out of his head, without being extremely well payed for the loss and pain."

In 1785 and 1786, Le Mayeur implanted one hundred and seventy teeth but a Philadelphia dentist named James Gardette claimed not a single one was successful. In fact, Gardette claimed he removed over fifty of Le Mayeur's transplants with his fingers.

The early centuries of decades of dental implant history were spent in coming to grips with the basic mechanics of the teeth and jaws, of learning fundamental lessons about the materials then current that would enable the long-term dental insertions, and in developing the early good theories and reliable tools for the tasks.

The early 19th century pioneers began to develop endosseous implantology, followed by those who developed subperiosteal implants.

EARLY DENTAL IMPLANT HISTORY-1800 TO 1950s

Early pioneers in dental implantology describe various materials used as transplants that included vulcanized rubber, porcelain and many different metals. In 1809, tooth implant materials were developed by Maggioli, who used gold roots and reported on the use of iron. Edwards, 1889, used platinum roots: Edmonds of New York in 1889 reported on the use of lead. In 1915, Widiman devised a method of autotransplantation of unerupted maxillary canines.

Others to mention briefly, all of whom performed successful reimplantations over this general span of time, were Roger of Paris 1844, Vassey 1861, Thompson 1881, Fredel 1887, Curtis 1890, Mendel-Joseph 1890, Fletcher 1891, Zoramenski in 1891 used teeth made of porcelain, Fuller 1899, C. Payne in 1900 used gold and iridium pins, R. Payne in 1901 used silver capsules. Farrett 1901, Wilkinson 1917 and 1926, Tomkins 1921, Tilley The Great Pioneers 1933. In the ensuing years, as information had accumulated about all types of organ transplants interests in transplanting teeth revived. Numerous transplants and research were completed from 1934 to 1955 and reported upon in literature both in the U.S. and Europe. Chronologically, the most important animal experiments in tooth transplantations had been undertaken by Higgins in dogs (1934), Bodecker and Lefkowitz (1935), Azhausen (1936), Hahn on dogs (1940), Wilfane on rats (1942), Sapiso on cats (1945), Alexander (1945), Maxmen (1945), Aveyzon on salamanders (1950) Fleming in guinea pigs (1952), Lovel and Hopper (1954), Vidain (1954), Sata on rabbits (1955), Agnew on monkeys (1955), Cserepfalvai on dogs (1955), Hammer (1955), Miller (1956), Emmerstein (1956). A tooth bank was developed in 1934 in Hungary by Cserepfalvi, and in Phoenix, Arizona by Pafford in 1953. In Europe, Silvestrini, Biavati, Bertolini, Andreasen, Mitchell, Cserepfalvi, Reming, Fong, Nordentram, Hubert, Chercheve and Azoulay contributed to tooth transplants.

An early insight to the process was provided by Gardette, who stated, "another tooth could have been found the root of which was exactly of the same length, size and form it might have been placed in the socket of the extracted tooth and it would certainly have become fixed and have lasted as long as the tooth which had grown in the socket."

Bugnot, in 1886, successfully transplanted embryonic teeth in other areas of the same mouth. Also, in 1886, Younger successfully transplanted a tooth into an artificial socket.

In 1887 Harris and 1888, Berry, implanted porcelain crowns fixed upon a platinum post around which lead was melted in a mold to resemble a tooth root.

Aside from animal studies, another factor in the renewed interest in transplants was the development of tooth banks. Cserepfalvi, while in Hungary in 1934, organized the first tooth banks. Later he moved to the United States and continued re-implanting teeth taken mostly from his orthodontic patients who had to lose their bicuspid teeth.

Pafford in 1953 organized the first American tooth bank in Phoenix, Arizona. Later, at the University of Tennessee a tooth bank was begun by Siskin, who eventually had Linkow vent-plant implants placed in his own mouth by Linkow himself.

In the 1950s, the method of transfer of partially developed third molars into the extraction sites of first molars was popularized by Miller, Apfel, Hale, and Clark and his coworkers.

A THOUSAND YEARS OF DENTAL IMPLANTS: A DEFINITIVE HISTORY - PART I

Man has been searching for ways to replace missing teeth from the earliest days. The ancient Egyptians implanted individual teeth, but usually only in corpses. Their religion required that a body be buried in as normal a state as possible so that it would enjoy full function in the afterlife.

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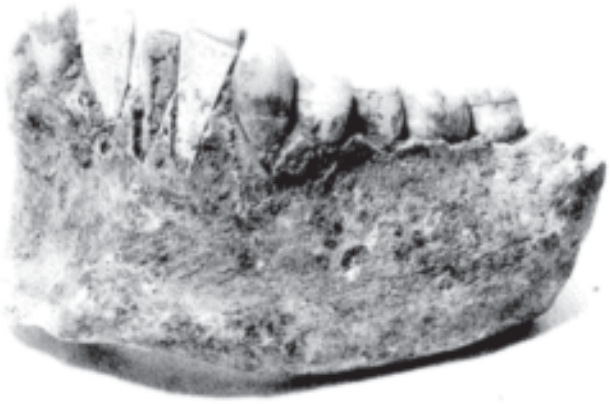


Fig. 25: Three Tooth-shaped pieces of shell History of Dentistry, by Dr. Malvin E Ring

The earliest true dental replacements were found among the early Etruscans, living in what is now modern Italy. These people buried their dead in decorated underground burial chambers, many of which have yielded innumerable treasures to modern archeologists. As far back as 2,500 years, the Etruscans learned to replace missing teeth with artificial teeth carved from the bones of oxen, and examples of this have survived in the tombs.

With the fall of Rome, almost all dentistry, as well as medicine, in the Western world came to a halt, not to be revived until the Renaissance. As previously mentioned, in 1563, Ambroise Pare, a French surgeon, published his epochal ***Dix Livres*** de la *Chirurgie* (Ten Books of Surgery), in which he described simple bridges. These consisted of carved ivory teeth inserted in a base of gold that was bound to the teeth on either side of the space with gold wires.

Again, in the 1720s, the "Father of Dentistry", Pierre Fauchard, devised different types of bridges and partial dentures to replace missing and extracted teeth. Building on his foundation, dentists in succeeding years modified and improved on his work. By the latter part of the 19th century, tooth replacement with fixed bridges and removable dentures had reached a relatively high plane.

However, dentists were dissatisfied with these prostheses. In most cases, two healthy teeth were cut down to anchor one replacement tooth. In partially or completely endentulous mouths, extensive whole or partial dentures were used that left much to be desired as far as eating or speaking were concerned. These unsatisfactory devices became the spur to replace individual teeth without bridgework. Thus, the struggle to successfully implant artificial teeth into the jaw bones was born.

WHY IMPLANTOLOGY HAS HAD A DIFFICULT TIME BEING ACCEPTED

Since its inception, the whole idea of implants has met with great skepticism or outright disdain, and it took many decades before being accepted into mainstream dentistry. Most dentists felt that implants just would not work because they had to contend with a wet, bacteria-laden environment. Added to that were the problems of the mucosal seal around the implant and bone maintenance and retention. Moreover, many clinicians were overzealous in reporting their experiences and, often failing to document their work and frequently ignoring the unsuccessful experiences of other investigators.

The earliest endosseous implant was made of an alloplastic (nonorganic) material and is undoubtedly that which was discovered by the archeological team of Dr. and Mrs. Wilson Popoenoe. While excavating at the Playa de 10s Muertas in the Ulloa Valley of Honduras in 193 1, they came upon a mandible fragment of Mayan origin, dating from about 600 AD. This fragment, now in the Peabody Museum of Archeology and Ethnology at Harvard University, has been studied by Professor Amadeo Bobbio of Sao Paulo, Brazil, a world-acknowledged authority on implants. He observed that three tooth-shaped pieces of shell had been placed in the sockets of three missing lower incisor teeth. Contrary to an earlier-held opinion that these had been inserted after death, Bobbio's X-rays, taken in 1970, showed compact bone formation around two of the implants. This bone was radiographically similar to that which would surround the blade implant or root form implant of today. Based on the radiographic appearance of the teeth and the small size of the jaw, Bobbio concluded that the jaw fragment was from a woman about 20 years old.

When somebody had a terrible toothache on the battlefield he would be brought to the ground by two or three soldiers while tooth would be "ripped" out of his mouth hopefully not to break any roots.

OTHER STONE IMPLANTS FOUND

Another remarkable find was made in 1890 in Copan, Honduras, by a team of archeologists from Harvard University. It was the skull of a young woman, which the archeologists dated to at least 1,000 years earlier (i.e., to about 800 AD). This skull also ultimately became part of the collection of the Peabody Museum. Its incisor teeth had been filed to points, while many were flattened out alone the incisor edges and these teeth also had stone inlays cemented into their labial surfaces. Dr RR Andrews of Cambridge, Mass., studied this skull and was astounded by a finding, which he described at a

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Fig. 26

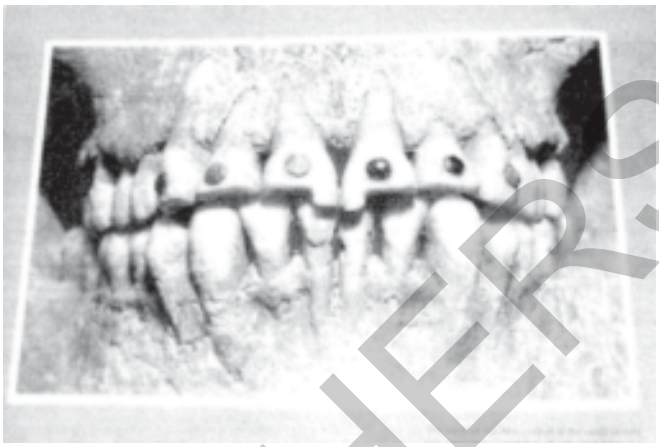


Fig. 27

meeting of the American Academy of Dental Science at Boston on October 4, 1893.

THE FIRST MODERN IMPLANT

What is probably the earliest reference to an implant in modern literature was described by J. Maggiolo, a dentist at the University of Nice, France. His work, Le Manuel de l 'Art d Dentiste, was published in 1809.

His procedure consisted of forcing a metallic tooth root made of 18-carat gold into the socket of an extracted tooth. This implant was shaped like a small tube with three prongs at the end, bent in on themselves to provide retention. The upper part of the implant had a hole in it into which the post of an artificial tooth could be inserted. The post was made firm with silk threads, which were wound around the post before insertion. Maggiolo then devised a novel method of retaining this superstructure —he drilled a horizontal hole through both the crown and post and inserted a pin to hold the crown to the post.

A LEAP FORWARD IN THE 19TH CENTURY—THE WORK OF JM YOUNGER

In 1885, Dr. JM Younger, working in the office of Dr. Edward Cameron Kirk (the latter was to become a leading figure in the profession as the editor of the widely popular Dental Cosmos, first demonstrated inserting a dried tooth into an extraction socket when, on June 15, 1885, he implanted a natural human tooth. An artificial socket was drilled in the bone with trephines and burs of increasing diameter, and the hole was adapted to approximate the size and shape of the intended implant. Through an apical opening, the pulp was removed from the tooth to be implanted and the canal was filled with gutta percha. The apical opening was then filled with gold, which was burnished and polished to a smooth finish. The tooth was soaked in a solution of bichloride of mercury for 10 minutes, washed, and then inserted into the artificial socket and ligated to the adjacent teeth for stability. A full report of his work appeared in the Dental Cosmos, giving it wide exposure.

Dr. Younger advocated securing a tooth from any source. He claimed that it did not matter how old the tooth was, the only consideration was the sterility of the implant. To test this, he implanted a 2,000 year-old tooth taken from an Egyptian mummy into the mouth of a willing patient! Naturally, this implant was soon rejected. Nevertheless, in spite of his obvious failures, Younger's work was the proof the profession needed to get working on the problem of implants. Here is seen stone inlays cemented into the labial surfaces of the teeth about 800 AD.

OTHER EARLY ATTEMPTS AT IMPLANTING

There were many dentists investigating the possibility of implanting foreign bodies in the jaws, but they were bedeviled by a host of problems. Dr. Chapin Harris, who flirted briefly with the idea of implanting, reported in his monumental work Principles and Practices of Dentistry, the ways some clinicians attempted to deal with these problems. He described how Dr. Herbst, using an extracted tooth as his implant in the maxilla,



Fig. 28: Implant of J Maggiob

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