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History of dental implantology

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Dr. Forrai Judit, D.Sc.,
Semmelweis University, Institute of Public Health, Department of History of Medicine, Budapest, Hungary.
forraijud@gmail.com

Dr. Andrew I Spielman, D.M.D, Ph.D., Professor of Molecular Pathobiology, Director Rare Book Library and Historical Archives, New York University College of Dentistry, New York, NY, USA.
ais1@nyu.edu

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Abstract

A *dental implant* is an artificial dental root inserted into the maxilla or the mandible to replace a missing tooth. Many materials have been used throughout history for this type of tooth replacement. Today, it is one of the most advanced subspecialties of dentistry.

Keywords

transplantation, aesthetic dentistry, oral surgery, periodontology, prosthodontics

The need to replace missing teeth has been a desire of humans for a long time. The existence of such demand is supported by archaeological evidence. An iron pin, dating to 300-250 B.C.E., replacing an upper incisor was uncovered at La Tène burial at Le Chene in northern France (1). A mandible fragment preserved in the Peabody Museum of Archeology and Ethnology at Harvard from a 7th-8th century C.E. individual has three inscribed shell pieces instead of three lower incisors (2). Another incisor root replaced with black stone from a foreign material can be found in the Mayan bone remains from Honduras, reported in 1893 (3). In Europe, in the 1500s and 1800s, there were several ways to implant animal teeth in humans. In 1685, Charles Allen proposed transplanting baboon, sheep, and dog teeth instead of those from humans. Giuseppangelo Fonzi (1768–1840) invented the porcelain (mineral) tooth in 1806, a discovery of great importance for the future of implant dentistry. This led later to the aesthetic and functional improvements of artificial teeth that remained unchanged in the mouth for years.

The first attempt at an endosteal metal implant followed Fonzi's work. In 1809, Maggiolo inserted a gold endosseous implant tube (a root) into a fresh extraction site. The surgical site was left to heal; subsequently, it became the anchor of the new tooth, upon which a crown was built. Later, based on his method, several types of implants were made of silver, porcelain, and iridium tubes (4). Many authors, e.g., Rogers (1845), Mitscherlich (1863), Younger (1885), Edmunds (1886), Harris (1886), Bonwill (1895), Edwards (1889), Payne (1898), and School (1905) described implants made with new materials. Unfortunately, these implants primarily failed because they were not biocompatible.

Knowing the limitations of natural tooth implantation or transplantation, Greenfield implanted an artificial hollow tube of iridio-platinum wire soldered with 24-carat gold (5). This *hollow basket* design was very

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similar to the design adopted many years later by the Straumann Group (Basel, Switzerland). Greenfield patented his idea in 1909 and reported in 1911 that the bone and gingival tissues tolerated metal endosteal dental implants well. This was further investigated in 1924 by Arthur A. Zierold, a surgeon at the University of Minnesota, who examined tissue reactions to gold, silver, aluminum, zinc, lead, copper, nickel, high-carbon steel, stellite, magnesium, iron, and copper-aluminum alloys in dogs. Implantation of these metals into the bone elicited different effects compared to a foreign body. The histological findings showed tissue acceptance (biocompatibility). Some of Zierold's observations were as follows: gold, aluminum, and stellite were inert substances, were easily tolerated by the bone, and were unaffected by living cells and body fluids; silver and lead were slightly less well tolerated, easily corroded, and caused a significant connective tissue reaction; zinc corroded quickly and caused a mild connective tissue reaction; copper stimulated bone, although it underwent slow corrosion; and steel and iron strongly inhibited bone regeneration. Le Fort confirmed Zierold's findings. Between 1936-38, surgeons San Antonio, Venable, and Stuck specifically looked at metal corrosion. In the 1930s, orthopedic surgeons Alvin and Moses Strock experimented with Vitallium, a cobalt-chrome alloy. They surgically placed the first successful endosteal implant. The field expanded using a diverse set of materials and implants.

In 1934, a thin screw made of stainless steel that passed from the root canal into the bone tissue provided a transradicular fixation. Perron Andres later modified a spiral-shaped stainless-steel implant developed by Formiggini with an occlusal tube. Casto's 1914 proposal is considered a rudimentary predecessor of this implant design. The transformation of the spiral into a double spiral by R. Chercheve in 1960 provided a better osseointegration.

The first subperiosteal Vitallium implants, developed by Dahl, appeared in 1940. The dense mesh structure found in the early version was later reduced, and for stability, it was screwed to the alveolus (Gershkoff 1947, Goldberg, Weinberg, and Lew, 1948). In 1940, Bothe, Beaton, and Davenport of Chicago, compared tissue reactions in animal models (cats), to several different metals (cadmium, manganese, aluminum, tin, lead, titanium, copper, stainless steel, and Vitallium) and investigated the potential role of electrolysis. Years later, titanium coating proved to be of great importance for osseointegration.

In 1951, Gottlieb S. Leventhal of Philadelphia found titanium ideal for implants because of its tensile strength, lightweight, and corrosion resistance. Brånemark, a Swedish orthopedic surgeon, used titanium for research in the mid-1950s and established that the material was firmly embedded in the bone and could withstand chewing and occlusal forces. He called this phenomenon *bone integration* or *osseointegratio*n (6).

The switch from Vitallium to titanium occurred during Lenard Linkow's blade implants. J. Scialom suggested a tantalum-niobium alloy needle implant instead of a blade. The needle shape already appeared in Lambotte's 1934 experiments, but only the so-called tripod method succeeded. From 1975, at Mondani's suggestion, the needles inserted into the bone were connected with an intraoral component using a telescopic system.

From 1976 onward, Schroeder and his colleagues proved with their extensive histological studies that a pseudo periodontal ligament was formed after an early or excessive implant loading. From the 1980s, the implants' shape did not change; the research direction focused on surface treatment to enhance osseointegration. Schröder and Straumann played a prominent role in this development with their systems created by different mechanical and chemical methods. (ITI system) (7). The spread of CAD/CAM

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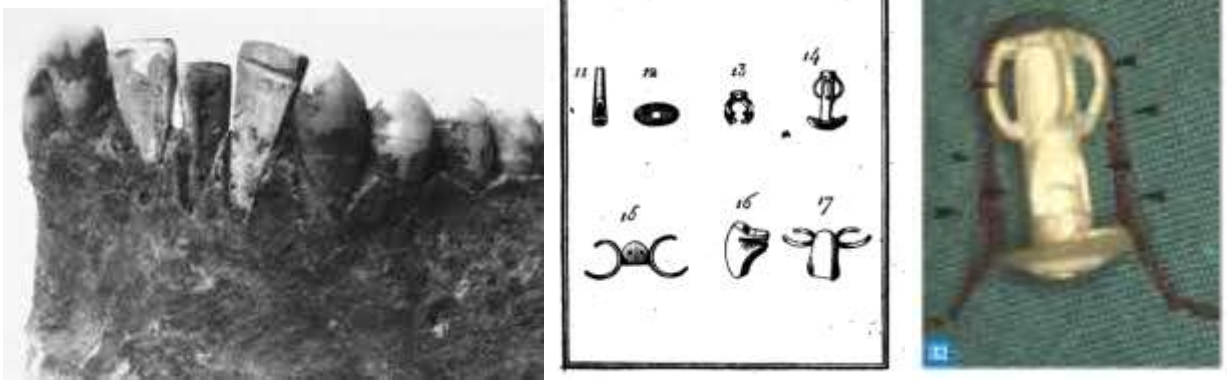
procedures in dentistry also brought the development of new implant materials. Today, implants are made of zirconium dioxide, classified as oxide ceramics (8).



A. B. C.

A. Mayan alloplastic implant (Peabody Museum, Cat. N. 20/54). B. Post and core supported crown (Maggiolo, 1807). C. A reproduction of Maggiolo's post and core

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