Acta Scientific Dental Sciences (ISSN: 2581-4893)

Volume 8 Issue 5 May 2024

Review Article

How Dental Implants have Changed through Time - A Literature Review

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DOI: 10.31080/ASDS.2024.08.1830

Received: March 22, 2024

Published: April 25, 2024

Abstract

The historical path of dental implants is a captivating expedition spanning centuries of ingenuity and progress in the field of dentistry. The notion of dental implants has undergone substantial evolution throughout history, tracing its origins to ancient civilizations like the Egyptians and Mayans. The inception of dental implants in the contemporary era can be traced back to the 1950s, when Swedish orthopedic surgeon Per-Ingvar Brånemark made significant contributions by uncovering the phenomenon of osseointegration. This significant advancement facilitated the progress in the field of titanium implants, enabling their flawless integration with the jawbone and establishing a secure base for the placement of prosthetic teeth. Since that time, the field of dental implant technology has experienced ongoing improvements and advancements. The utilization of ceramic and zirconia in materials science has enhanced the visual appeal and long-lasting nature of implants. The success rates of implant treatments have been improved by advancements in implant design, including the implementation of tapered implants and surface alterations to facilitate speedier integration. In contemporary dentistry, dental implants have emerged as the prevailing method for tooth replacement, providing individuals with a durable and visually authentic remedy for tooth loss. The historical development of dental implants exemplifies human creativity and the unwavering commitment to achieving the highest standards in oral healthcare.

Keywords: Dental Implants; Evolution; Development; Tooth Loss

Introduction

Dental implants have significantly transformed the domain of dentistry by offering a dependable and enduring remedy for tooth loss. It is imperative for dentists to be abreast of the most recent breakthroughs in dental implant technology. A dental implant refers to a fabricated structure composed of alloplastic materials that is surgically placed into the oral tissues, namely beneath the mucosa and/or periosteum, and/or into or through the bone. Its primary purpose is to offer retention and support for a dental prosthesis, which can be either fixed or detachable.[1] The objective of this literature review is to examine the historical development of dental implants, emphasizing the notable transformations that have taken place.

Historical context

Oral surgery, also known as exodontia, is the oldest dental profession, with implant dentistry being the second oldest. In approximately 600 AD, the Mayan civilization employed fragments of shells as dental implants for the purpose of substituting mandibular teeth. The insertion of a gold implant into a newly extracted location was performed by J. Maggiolo in the year 1809. In the year 1930, the Strock brothers employed Vitallium screws as a means of tooth replacement. In the 1940s, Formiggini, the pioneer of modern implantology, and Zepponi invented a post-type endosseous implant. The development of the subperiosteal implant can be attributed to Dahl in Sweden during the 1940s [2]. The two-stage screw implant, which was implanted without the need of a permucosal post, was created by Strock in 1946. Following the complete healing of the implant, the abutment post and individual crown were subsequently incorporated. The current preferred implant interface is referred to as ankylosis. Blade implants, which are now known as endosseous implants, were first introduced by Dr. Linkow in 1967. The scientific foundation of dental implants was

established following the fortuitous creation of Dr. Branemark, who played a pivotal role in the development of the osseointegration concept. This idea involves the direct and hard connection of dental implants to the bone, without the presence of any intervening tissue between the implants [2,3].

Initial dental implants

Dr. Per-Ingvar Brånemark, an orthopedic surgeon, pioneered the development of the initial contemporary dental implant throughout the 1950s. During the course of his investigation on blood flow in rabbits, he fortuitously encountered the phenomenon of osseointegration, which involves the fusion of bone with implant material [4]. The aforementioned finding established the groundwork for subsequent progressions in the field of dental implantology.

Surgical approach

Over the course of time, three surgical methods have been employed. There are three types of loading: two-stage, one-stage, and immediate-loading. The surgical technique consists of two stages [5]. Initially, the implant body is positioned beneath the soft tissue until the bone starts to recover. This typically takes 2 to 3 months for the mandible and 3 to 6 months for the maxilla. In the subsequent phase of surgical intervention, the removal of soft tissues is performed in order to affix a permucosal element or abutment. The one-stage surgical method involves the simultaneous placement of the implant body in the bone and the permucosal element above the soft tissue until the initial bone maturation has taken place. The implant's abutment subsequently substitutes the permucosal portion, eliminating the necessity for a subsequent soft tissue surgery. In the immediate-restoration technique, the implant body and prosthetic abutment are positioned during the initial surgical procedure, followed by the attachment of restoration, typically transitional in nature, to the abutment [6].

Progress in the field of material science

One of the notable transformations in dental implants is to the selection of materials employed. During its first stages, implants were predominantly composed of materials such as stainless steel and titanium alloy.[7] Nevertheless, the field of material science has witnessed significant progress, leading to the introduction of a wider range of biocompatible materials. Currently, pure titanium is widely employed as the predominant material for dental implants owing to its exceptional biocompatibility and robustness [8].

Enhanced implant design

The design is another vital part in the evolution of dental implants. In the initial stages, dental implants were comprised of a cylindrical device that was directly inserted into the mandible [9]. Over the course of time, scholars and researchers have dedicated their efforts towards enhancing the design in order to augment both stability and functionality. Contemporary dental implants currently exhibit a tapered or screw-type configuration, hence facilitating enhanced initial stability and augmented surface area for the process of osseointegration [10].

Advanced dental technology and precision implant placement

The advent of digital dentistry has revolutionized the procedure of dental implant installation. Dentists can now generate accurate 3D models of the patient's mouth using cone-beam computed tomography (CBCT) images and computer-aided design/computer-aided manufacturing (CAD/CAM) technologies. This technique facilitates the precise placement of implants, hence enhancing accuracy and mitigating the potential for problems [11].

Reduced duration of treatment

The progress made in dental implant technology has resulted in a decrease in the duration of therapy. Previously, patients were required to endure a waiting period of several months prior to the placement of the ultimate repair on the implant. Nevertheless, by the implementation of strategies such as quick loading and the utilization of temporary restorations, patients are now able to depart from the dental facility with fully operational teeth on the very day of implant placement [12].

Enhancements in the functionality and aesthetics of dental implants

In the past few years, there have been notable progressions in the biomechanical design of dental implants, resulting in enhanced load distribution and less strain on adjacent bone. Furthermore, advancements have been made in the development of prosthetic components including as abutments and crowns, with the aim of improving both their functionality and visual appeal. The advancements in implant-supported restorations have not only resulted in enhanced chewing efficiency but have also played a role in creating a more authentic smile, hence augmenting patient happiness [13].

Enhanced rates of success

With the advancement of dental implant procedures, there has been a substantial enhancement in success rates. Research findings indicate that the efficacy of dental implants has surpassed 95%, rendering it a very reliable and effective therapeutic alternative for individuals experiencing tooth loss [14]. The aforementioned phenomenon can be ascribed to the progressions in implant design, materials, and surgical methodologies.

The scientific significance of dental implants

The objective of contemporary dentistry is to reinstate the patient's stomatognathic system to its normal profile, function, comfort, esthetics, speech, and overall health, irrespective of any atrophy, disease, or injury.

The average lifespan of individuals is increasing. The combination of this reality, along with a preexisting patient group experiencing both minor and serious dental issues, ensures the long-term

viability of implant dentistry for multiple generations of dentists. The utilization of dental implants for the purpose of tooth replacement, particularly in the posterior areas of the oral cavity, is seeing a growing trend. A dental implant can replace a single tooth instead of removing healthy tooth structure and crowning multiple teeth, which can increase the risk of decay. Additionally, endodontic therapy and splinting teeth with pontics may reduce oral hygiene ability and increase plaque retention.

Implant dentistry has been officially embraced by organized dentistry. The ongoing trend towards the widespread use of implant dentistry is expected to persist until all restorative practices consistently utilize this modality as the preferred choice for abutment support in both fixed and removable prostheses for all tooth replacement procedures [15].

Dental implant complications

A multitude of issues and challenges may arise both during the surgical procedure and in the postoperative period. During the operation, it is possible to observe perforated buccal or lingual plates. If an elliptical or eccentric preparation is present, it may be appropriate to utilize a broader implant, if feasible. If not, the osteotomy should be filled with an autogenous graft, compressed, and subsequently repositioned with the implant. The occurrence of bleeding in the floor of the mouth can be attributed to an injury in either the lingual artery or the facial artery [16]. It is imperative to exercise utmost caution during the process of osteotomy preparation. Nerve damage has the potential to result in modified nerve perception, manifesting as anesthesia, paresthesia, or hyperesthesia. As a result, it is common practice to establish the surgical landmark at a conservative distance of 2mm above the mandibular canal [17].

Incision line opening is the prevailing postoperative complication. The process of designing the removable interim prosthesis is intricate and requires accurate adjustments. The patient is advised to perform a daily rinsing regimen consisting of 2-3 rinses using chlorhexidine. Epithelial margin trimming can be performed if the granulation process exceeds a duration of two weeks. In the event that implants become exposed throughout the healing process, it is imperative to refrain from any endeavor to conceal them with tissue. The denture is aggressively eased over the region where the implant is exposed. The occurrence of implant mobility throughout the healing process is unusual, yet possible, sometimes accompanied by the presence of a radiolucent zone surrounding the implant [18]. Regardless of the underlying cause, it is imperative to remove the implant. The indications and manifestations of implant failure encompass horizontal mobility exceeding 0.5 mm, accelerated and progressive bone loss, pain experienced during percussion, uncontrolled exudate production, widespread radiolucency surrounding the implant, a loss of more than 50% of the bone surrounding the implant, and the insertion of implants in an inadequate position rendering them unsuitable for prosthetic support. The minimal criteria for success are a success rate of 85% at the end of a 5-year period and 80% at the end of a 10-year period [19].

Prospects for dental implant technology in the future

The advent of nanotechnology and bioengineering applications presents promising prospects for the future of dental implants. Scientists are currently investigating innovative implant materials and surface coatings in order to improve the process of osseointegration and minimize the adhesion of microbes. In addition, the use of digital dentistry equipment such as intraoral scanners and CAD/CAM technology is optimizing the placement process of dental implants and enhancing the results of therapy [20]. The aforementioned breakthroughs possess the potential to significantly transform the domain of implant dentistry, presenting novel remedies for those who experience tooth loss.

Conclusion

The development of dental implants has made significant progress since their debut. The discipline of dental implantology has experienced significant improvements, ranging from the fortuitous identification of osseointegration to the use of digital dentistry. The implemented modifications have not only resulted in superior patient outcomes but have also contributed to an improved overall experience for both dental professionals and patients. In the field of dentistry, it is imperative for practitioners to be abreast of current research and breakthroughs in dental implant technology in order to deliver optimal treatment to their patients.

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