

Implant Abutment: A Vital Link in the Success of Implant Restoration

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ABSTRACT

Dental implants serve as a vital solution for replacing missing teeth. They offer excellent support for both fixed and removable prostheses, enhancing function and aesthetics. Understanding the biomechanics related to dental implant therapy is crucial, and one critical aspect is the selection of implant abutment. Due to increase in the availability of implant therapeutic components, the selection of an appropriate dental implant abutment for a given clinical situation has become extremely challenging. There are essential key factors to be kept in mind while making selection for an implant abutment. Different types of implant abutments are available in various categories based on different factors like retention (screw-retained, cement-retained), angulations (straight or angled), design (stock, custom, CAD/CAM-milled) and fabrication (prefabricated or custom-made). Aim of this article is to discuss different categories of implant abutments to make the implantologist updated about the different implant abutment options available in the market and to empower them to make informed decisions and deliver optimal care to their patients whether it's a single tooth restoration or more complex ones, for long-term success of treatment

Keywords: Dental Implant- Abutment, Dental Implant, Implant Abutment Connection

INTRODUCTION

Dental implant therapy has emerged as a rapidly growing and promising approach for rehabilitating completely and partially edentulous patients. [1, 2] A dental implant consists of three components namely fixture that acts as the artificial root, abutment which connects the implant to the crown and crown or prosthesis which is the visible tooth that rests on the abutment, mimicking natural teeth. Abutments play a crucial role in connecting the crown or other dental restorations directly to the implant. An abutment has various components like

implant connection segment, transgingival segment and prosthesis connection segment. Implant connection segment fits into the internal core of the implant and serves as the foundation for the abutment. The transgingival segment protrudes above the soft tissues and acts as the prosthetic retainer, connecting the implant to the crown. Prosthesis connection segment provides the link between the abutment and the crown, completing the dental restoration process. [3] Grossly we have either a stock abutment which is prefabricated or readymade abutment that can be angled or

straight. The custom abutment is an abutment designed and fabricated as per the individual need for a particular clinical situation. A wider option of abutment available in various clinical scenarios is definitely a boom in implant dentistry. But too many choices also create a major confusion unless there is a clear understanding as to what are these choices and how to filter them and select the desired ones for our need. The field of implant manufacturing is indeed a dynamic landscape with numerous companies contributing to the development of implant systems. However, this diversity also brings challenges, particularly when it comes to standardization and universality of abutments. Abutment is a vital component of the implant system which eventually helps to form the implant prosthesis. Also, the choice of the prospective abutment can be done much in advance if the case has been meticulously planned before the diagnostic wax up and mock teeth set up, by use of radiographic and surgical guide. So, when navigating the plethora of abutment choices, it's essential to select the most suitable option for the unique clinical scenario.

HISTORY OF DENTAL IMPLANT ABUTMENTS

The evolution of dental implant abutments has been a fascinating journey, with various materials and designs emerging over the years.

Early Crown: First crown -complex abutment was introduced in 1986 for single tooth restoration. [4] This crown complex was mainly composed of acrylic resin crown veneered onto prefabricated machined titanium. [4, 5] Subsequently, this one-piece complex changed into two-piece complex for obtaining better esthetics. This two-piece restoration consisting of a cemented metal-ceramic crown that was supported by a prefabricated titanium abutment. [4]

UCLA Custom Cast Metal Abutment: In 1988, the University of California, Los Angeles (UCLA), introduced a custom cast metal component that could be screwed onto the implant. [6]

This abutment gained popularity for both screw- and cement-retained implant-supported restorations due to its versatility and clinical success. Research has shown that metal abutments are commonly used in both anterior and posterior regions. [7-10] However, in the anterior region (which is critical for aesthetics), metal abutments face limitations and disadvantages. Patients with a high or gummy smile line may experience a blue-grayish color reflection from the peri-implant site gingiva due to metal abutments, potentially compromising treatment success. [11-14]

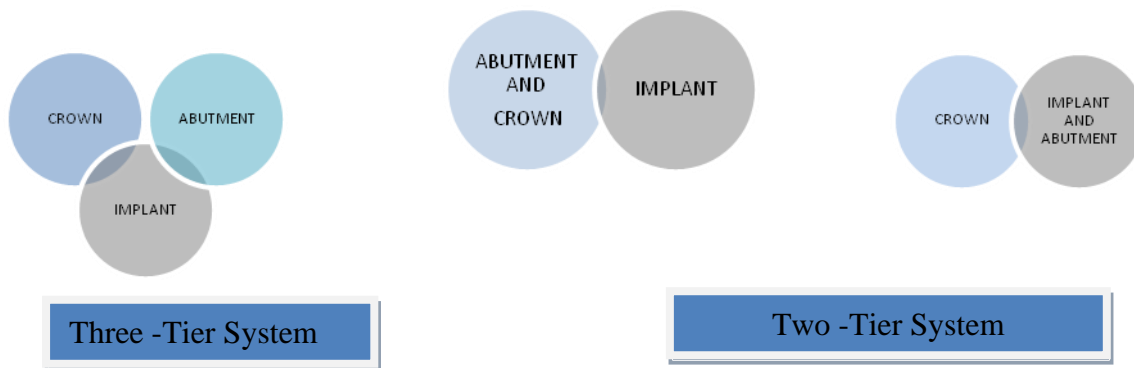
Alumina Ceramic Abutments: In 1993, Prestipino and Ingber introduced densely sintered alumina ceramic abutments as a solution to aesthetic challenges related to metal abutments. [15-18] Alumina ceramic abutments, coupled with advancements in CAD/CAM technology, marked a significant development in implant dentistry and were extensively studied in clinical settings. [19]

Yttrium-Stabilized Zirconia Abutments: In 2004, Glauser et al. introduced densely sintered yttrium-stabilized zirconia as an alternative abutment material to alumina. [20] Zirconia abutments allowed for the replacement of missing anterior teeth with implant-supported restorations that achieved ideal aesthetics and function. Initially, zirconia abutments were manually produced using copy-milling techniques and customized resin patterns. Later zirconia abutments with CAD/CAM system led to most significant improvements in implant dentistry. When comparing zirconia to titanium, zirconia metal abutments offered several biological advantages like less bacterial adhesion and more biocompatibility due to lack of corrosion and galvanic coupling. [21-23]

CAD-CAM systems: Its implementation in dentistry has significantly influenced the evolution of dental implantology and implant-supported prosthetics over the past three decades. It has allowed the fabrication of custom abutments that can be manufactured from either titanium or ceramics. [24] Currently, preparation of individual custom abutments is also possible in accordance with the patients' anatomic needs and/or with the ideal emergence profile of the missing tooth. [25]

DENTAL IMPLANT-ABUTMENT CONNECTION

The implant-abutment connection (IAC) is a crucial aspect in the success of dental implant. It plays a critical role in ensuring long-term success and stability in implant dentistry. It is of three types -external connection, internal connection and conical connection. External connection was the first connection system that was endorsed by Branemark. Internal connection helps absorb load due to lateral forces. Conical connection prevents the mechanical friction between the attachment wall and the implant. [26, 27] The combination of the final restoration to the implant platform can either be planned as three-tier or two-tier system.



As a name suggests, implant three-tier system incorporates three different components-the Implant, the abutment and the crown. The two tier system incorporates two different components - the abutment and the crown form a single unit and the implant is a different component or reciprocally, the implant and the abutment form a single unit and the crown is a different component. [25] Implant systems can be classified as a one or two-piece implant system. In the one-piece (one-stage, non submerged) implant system, the connection is usually placed supra-gingivally. In the two-piece (two-stage, submerged) system, the connection between the implant and the abutment is usually placed at/or below the crest of the bone. [28]

IMPORTANCE OF PROPER ABUTMENT SELECTION FOR DENTAL IMPLANT

The abutment selection for dental implants is a critical aspect that significantly impacts the long-term success and overall appearance of the final restoration.

Proper Fit and Support: The abutment acts as the bridge between the dental implant and the final restoration (such as a crown or bridge). Ensuring a secure and stable fit is essential for the **long-term success** of the implant. Proper support from the abutment helps distribute forces during biting and chewing thus preventing complications.

Esthetics: Abutments come in various materials, each affecting the overall appearance of the restoration. Titanium abutments are commonly used due to their strength and biocompatibility. Zirconia abutments offer excellent esthetics, as they

closely resemble natural teeth. Hybrid abutments combine the benefits of both materials.

Functionality: The abutment’s design impacts functionality. Angled abutments accommodate implant placement in non-ideal positions. Custom abutments can be tailored to individual patient needs, considering factors like quality of bone and thickness of gingiva. Proper alignment ensures even force distribution during chewing.

Individualized Treatment: Each patient’s case is unique. Factors like bone density,

gingival health, and implant location influence abutment selection. Dental professionals assess these factors to choose the most suitable abutment.

Longevity: Custom abutments are precisely fitted, reducing the risk of complications.

CLASSIFICATION OF DENTAL IMPLANT ABUTMENT [25, 29, 30]

Dental implant abutments play a crucial role in implant-supported restorations. The different classifications based on various factors are:

1) On the basis of permanency/durability:	1) Temporary abutment Impression abutments Healing abutments and cover screws Metal and Plastic provisional abutments 2) Definitive abutment Standard stock- Ti and Zr (cement) Custom castable-Ti and Zr (cement or screw) Computer generated (VAD /CADD). Ti, Al, Zr (cement or screw)
2) On the basis of retention:	1) Screw retained 2) Cement retained
3) On the basis of angulations	1) Non-angled abutment 2) Angled abutment
4) On the basis of connection to the abutment	1) External 2) Internal 3) Connection with anti rotational feature 4) Connection without anti rotational feature
5) On the basis of fabrication	1) Prefabricated (unmodified or modified) 2) Customized cast abutment Customized copy-milled abutment Customized CAD-CAM abutment Customizing prefabricated abutments
6) On the basis of Implant-abutment mating surfaces	1). A butt joint 2) A slip joint
7) On the basis of nature of fit between the implant and the abutment	1) A slip fit 2) A friction fit
8) On the basis of the shape (geometry)	1) Hexagonal 2) Octagonal 3) Cone (Conical) screw 4) Cone hex 5) Cylinder hex 6) Spline 7) Cam 8) Cam tube 9) Pin/Slot
9) On the basis of material	1) Titanium 2) Complete zirconia 3) Zirconia with a titanium base (zirconia-titanium hybrid abutment) 4) Cast metal (noble, high noble, or base metal alloy) 5) Cast metal with porcelain fused at the base 6) Alumina 7) PEEK (Poly-ether- ether-ketone)

FACTORS TO CONSIDER WHEN SELECTING THE DENTAL IMPLANT ABUTMENT

Selecting the right abutment for a dental implant is crucial for achieving optimal results. The essential factors to consider when making the decision are:

1. Aesthetic requirements: Aesthetics play a significant role in selection of an abutment for anterior teeth. Zirconia or custom abutments provide a natural appearance and blend seamlessly with adjacent teeth.
2. Functional demands: Molars endure substantial biting forces during chewing.

Therefore, it's advisable to opt for durable materials like titanium. Titanium abutments offer excellent strength and longevity.

3. Anatomical conditions: If the natural bone anatomy is compromised (e.g., due to bone loss), angled abutments may be an alternative. These allow proper alignment and support for the final restoration.
4. Biocompatibility: Patient's overall health and any existing allergies are to be considered. Abutment material that is biocompatible and won't cause adverse reactions should be chosen.

RECENT ADVANCES IN DENTAL IMPLANT ABUTMENTS

With the advent of intraoral and desktop scanners, dental implant positions can now be accurately digitized. This digitalization has revolutionized the selection and fabrication of dental abutment materials.^[31] Custom-made abutments play a pivotal role in modern Prosthodontics. These meticulously crafted components are tailored to fit each patient's unique anatomy, ensuring optimal function and aesthetics. These personalized abutments ensure optimal fit, aesthetics, and function for each patient. Custom abutments allow for better adaptation to individual anatomical variations. Computer-aided design and computer-aided manufacturing (CAD/CAM) technology have streamlined abutment production. CAD/CAM abutments are precisely milled from high-quality materials, providing excellent fit and durability. They offer flexibility in design, allowing for customized emergence profiles and optimal soft tissue management. Scan bodies are used during the digital impression procedure. They facilitate accurate transfer of implant positions to the digital workflow, ensuring precise abutment fabrication.^[32]

SUMMARY

The journey from acrylic resin crowns on titanium abutments to advanced ceramic and

zirconia abutments has significantly improved implant dentistry, offering better aesthetics and functional outcomes. Implant abutment connection determines joint strength and stability of the dental implant system. It is important to select the proper abutment as it ensures proper fit, support, esthetics, functionality and longevity of the treatment. Various factors are to be considered while selecting the right abutment for a dental implant like material used, implant position, patient-specific factors (e.g., bone quality, gingival thickness), and esthetic requirements. For the success of the implant prosthesis, many factors are to be considered while selecting the abutment like esthetics that is best provided by Zirconia. Another factor is functional demands of the patient as the posterior teeth endure greater biting forces; hence titanium abutments should be considered. Bone anatomy is to be considered and accordingly angled abutments for proper alignment should be chosen. Researchers continue to explore innovative materials and designs to enhance patient care and satisfaction. Lastly, a biocompatible material that does not cause any allergies must be considered. The success of a dental implant relies on meticulous planning, precise placement, and the appropriate choice of abutment. Dentists carefully consider factors such as bone quality, soft tissue health, and patient preferences when selecting and placing abutments. The newer advancements in the abutments, helps to improve and customize the emergence profiles and optimal soft tissue management.

CONCLUSION

In the realm of dental implant restorations, the choice of abutment plays a crucial role in achieving optimal outcomes. A dental implantologist must have in depth knowledge of various available abutment options enabling him to offer better aesthetics and functional outcomes to the patient. Researchers continue to explore

innovative materials and designs to enhance patient care and satisfaction.

Declaration by Authors

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