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TYPES, DESIGNS, AND INDICATION OF DENTAL IMPLANT ABUTMENT

A project submitted to
Department of prosthodontics, the College of dentistry,
University of Baghdad, in partial fulfillment for degree of the
bachelor in Dental Surgery

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SUPERVISOR CERTIFICATION

This is to certify that this project was organized and prepared by the under graduate student “Kanary Amer Ibrahim” under my supervision in the Department of Prosthodontics, College of Dentistry / University of Baghdad, as partial fulfillment of the requirements for the degree of bachelor in dental surgery.

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DEDICATION

I would like to dedicate this work to everyone who supported and inspired me during my studying carrier.

To my loving parents, who have been a constant source of support and encouragement during the challenges of school and life.

To my teachers, who conveyed their knowledge and experience and taught us the value of hard work.

To my friends, who kept me going and provided continuous support throughout the process.

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LIST OF ABBREVIATIONS

CEJ	Cemento-enamel junction
MUA	Multi-unit abutment
Ni	Nickel
PEEK	Polyetheretherketone
PFM	Porcelain fused to metal
PMMA	Polymethylmethacrylate
SRC	Screw-retained crown
SS	Stainless steel

INTRODUCTION

INTRODUCTION

Prosthodontics is a crucial aspect of dentistry that deals with the restoration and replacement of missing teeth, which plays a significant role in maintaining and improving patients' oral health, function, and esthetics. Prosthodontists use advanced techniques and materials to design and fabricate dental prostheses that mimic natural teeth in appearance, feel, function and replacement of missing teeth by using dental implants (Shafie, 2014).

Dental implants have effectively added to restorative alternatives for treating both totally and partly dentate patients, restoring their masticatory function. Over the course of nearly five decades, implant dentistry has progressed, as restorative approaches and components, to meet the high demands of a variety of complex clinical circumstances. This situation puts the physician in the difficult position of having to choose a suitable abutment to complete the case satisfactorily, especially if the implant placement was complicated or compromised (Shah et al., 2014).

Dental implant abutment is that portion of a dental implant that serves to retain a prosthesis. There is wide variety of implant abutments, which can be manufactured in different designs according to a specific criterion. The dental implant industry has a wide range of abutment materials to choose from, each has its own unique properties. Abutment connects to the implant and restoration by several means (Misch, 2021; Shah et al., 2014; GPT, 2017).

Despite these beneficial feature of implant abutments, many complications exist which can affect the retention of implants leading to implant failure, compromising patients’ quality of life (Misch, 2021).

To select the appropriate abutment for each patient, there are several features that should be adhered to by the dentist. Till the present day, the manufacture of new types of abutments is still undergoing, reflection the importance of these elements (Prakash and Gupta, 2017; Karunagaram et al., 2013).

AIMS OF THE STUDY

Define implant abutments, review the different types of implant-abutments designs, abutment materials, types of connections to the implant and restoration, criteria for selection, and different implant abutment complications.

CHAPTER 1

REVIEW OF LITERATURE

CHAPTER 1 REVIEW OF LITERATURE

1.1 Implants in dentistry

Dental implants are widely employed and are considered to be one of several treatment options that can be used to replace missing single tooth and multiple teeth, as well as a completely edentulous jaw because of their excellent durability, strength, and esthetics; which are artificial titanium fixture that are placed surgically into the jaw bone (Fig 1.1) (Kalpana, 2020).

Dental implant can provide to restore dental patients to optimal form, function, confidence, comfort, and esthetics (Shah et al., 2014; Resnik and Misch, 2021).

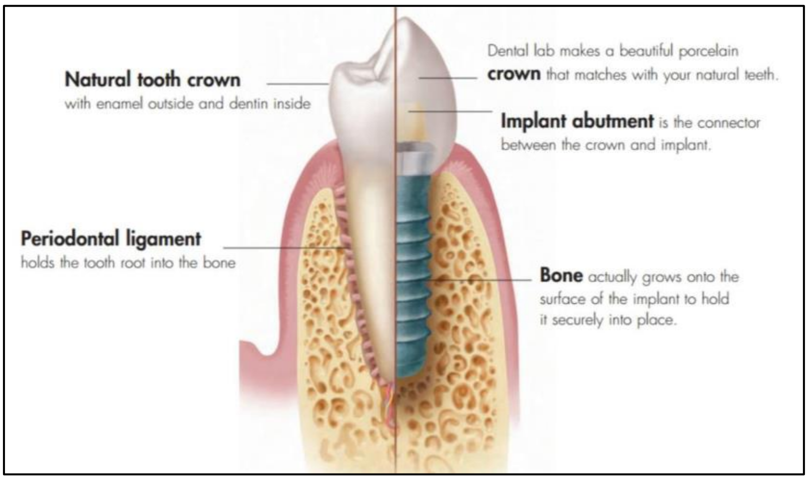

Figure 1.1: Natural tooth and dental implant (Prakash and Gupta, 2017).

1.1.1 Structure of dental implant

The Components of dental implants in general include implant body or fixture, abutment and crown (Fig 1.2) (Prakash and Gupta, 2017).

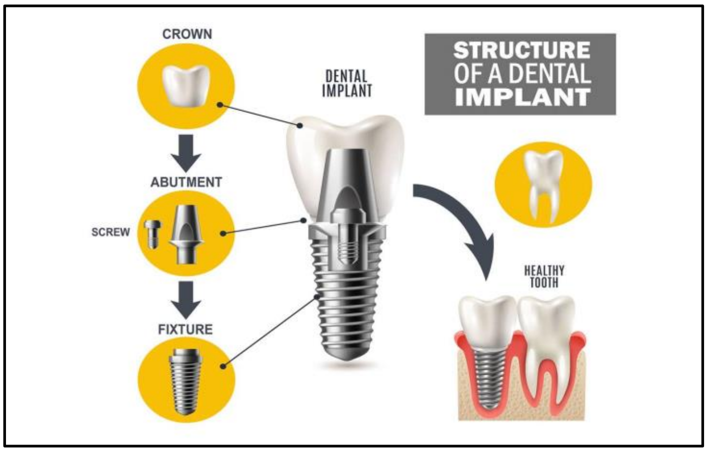

Figure 1.2: Components of dental implants (Clinic, 2022).

1.2 Dental implant abutment

Dental implant abutment is that portion of a dental implant that serves to support and/or retain a prosthesis; it is that part of a structure that directly receives thrust or pressure; an anchorage (GPT, 2017).

Dental implant abutment location is intermediate between the implant and the restoration and is retained to the implant by a screw or locking taper (Karunagaram et al., 2013).

The quality, precision, stability, strength, and proper-fitting of abutments are essential to implant success. Abutments form the restorative part of the implant prosthesis and provides the retention, support, stability, and optimal position for the final restoration. They have a direct impact on the long-term prognosis of this treatment modality (Prakash and Gupta, 2017; Diana, 2018; Misch, 2021).

1.3 Segments of implant abutment

Any abutment can be divided into three segments (Fig 1.3). Prosthesis connection segment which connects to the prosthesis, implant connection segment which connects with the implant, and trans-gingival segment which is surrounded by the gingival tissue above the prosthetic platform of the implant (Shafie, 2014).

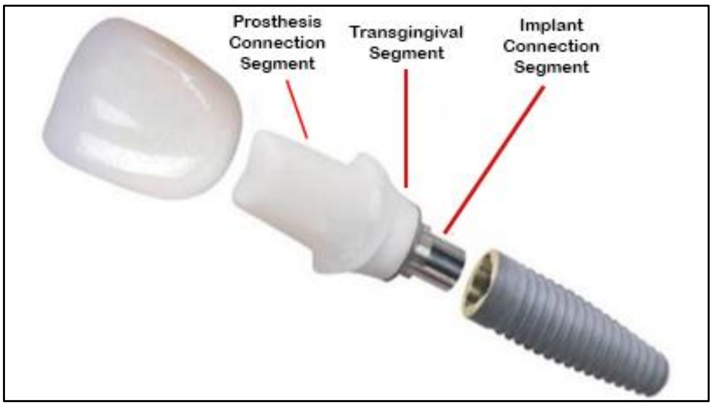

Figure 1.3: Segments of an implant abutment (Shafie, 2014).

1.3.1 Implant connection segment

The implant connection part of the abutment should not be altered, but the other two parts have to be modified in order to optimize the outcome of implant treatment (Shafie, 2014).

1.3.2 Transgingival connection segment

The transgingival part of the abutment needs to be customized based on the thickness of the gingival above the prosthetic platform of the implant, the desirable emergence profile for the tooth that is being replaced, the overall prosthetic plan, and finally, hygiene and maintenance objectives (Shafie, 2014).

1.3.3 Prosthesis connection segment

The prosthesis connection segment should be modified based on the size, shape, and emergence profile of the prosthesis, interocclusal or inter-ridge spaces, shape and size of the interdental papilla, the desirable embrasure (‘V’-shaped gap between the neck of two teeth or crowns that will be filled with gum) and finally, the clearance required based on the material that will be used to fabricate the final crown (Shafie, 2014).

Less reduction is needed for a gold crown and more reduction for PFM (porcelain fused to metal) and all ceramic crown (Shafie, 2014).

1.4 Types of abutment connection

Three main types of implant abutment designs exist. These include: Threaded, Frictional, and non-threaded (Karunagaran et al., 2014; Kalpana, 2020).

1.4.1 Threaded abutment

Threaded abutment can be straight, prefabricated angled and custom-made. Straight threaded abutments (Fig. 1.4) are used when axial inclination and parallelism of implants are favorable (Kalpana, 2020).

Pre-fabricated angled designs are not available from all manufacturers. Custom abutments (angled & straight) are made by making impressions or by direct resin patterns (Kalpana, 2020).

Figure 1.4: Straight threaded implant abutment (Kalpana, 2020).

1.4.2 Frictional / Press fit

Straight and angulated variants are available with an angle of 15 degrees. To insert, the head is oriented correctly and tapped firmly with a mallet. It is impossible to remove it after tapping (Fig 1.5) (Kalpana, 2020).

Figure 1.5: Press fit abutment (Kalpana, 2020).

1.4.3 Non threaded, cementable

This type of abutment relies on cement retention to secure the implant restoration in place. It is often used for cement-retained implant restorations. They are less likely to create implant fractures or abutment screw loosening and offer better esthetics (Kalpana, 2020).

1.5 Materials of abutments

A wide variety of abutment materials are available on the dental implant market. A major challenge for clinicians today is understanding the biologic response to each material, as well as the best indication for using each of the different types (Shafie and White, 2014; Pisulkar et al., 2021).

1. Titanium abutments: The titanium is the only element that offers the unique combination of strength, light weight, and biocompatibility, as well as being extremely durable and strong (Shafie and White, 2014).
2. Stainless steel abutments (SS): The surgical stainless steel is a specific type of stainless steel used in medical applications, and includes alloying elements of chromium, nickel (Ni), and molybdenum. Surgical grade stainless steel can be used for temporary implant abutments in the short term only since the immune systems reacts to the nickel in stainless steel (Shafie and White, 2014).
3. Gold abutments: Due to contradictory research, clinically it would be prudent to use gold abutments cautiously (Shafie and White, 2014).
4. Zirconia abutments: Zirconia is the most hygienic abutment on the market and maintains the mucosal seal better than titanium (Shafie and White, 2014).

5. Polyetherethrketon (PEEK) abutments: When used as a temporary restorative abutment, a clinician should expect a similar soft tissue response as seen with the use of titanium (Shafie and White, 2014).

1.6 Types of dental implant abutment

Abutments can be divided into two forms: temporary abutments and definitive abutments (Fig 1.6).

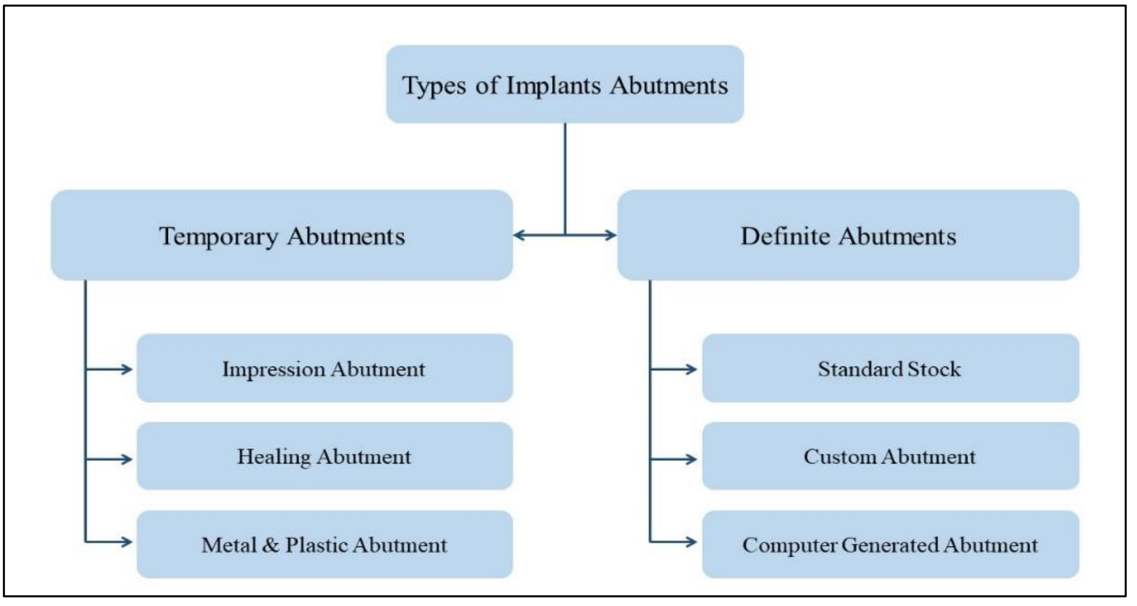

Figure 1.6: Temporary and definite abutment (Karunagaran et al., 2014).

1.6.1 Healing or Interim abutment

Healing abutments (Fig 1.7) are dome-shaped intra-implant screws that provide per-mucosal access to the implant platform. Healing abutments are placed at the completion of the implant placement surgery in a one-stage surgical approach or after uncovering in a two-stage surgical approach (Hupp et al., 2018).

They are made of titanium or titanium alloy and can be parallel, walled or tapered and range in height from 2 to 10 mm. The healing abutment should project 1 to 2 mm superior to the height of the gingival tissue (Hupp et al., 2018).

Figure 1.7: Healing abutment (Hupp et al., 2018).

1.6.2 Impression abutments

Open tray impression abutments are often called pick-up or direct copings. Closed tray impression abutments are often called Transfer or indirect copings (Fig 1.8) (Karunagaram et al., 2013).

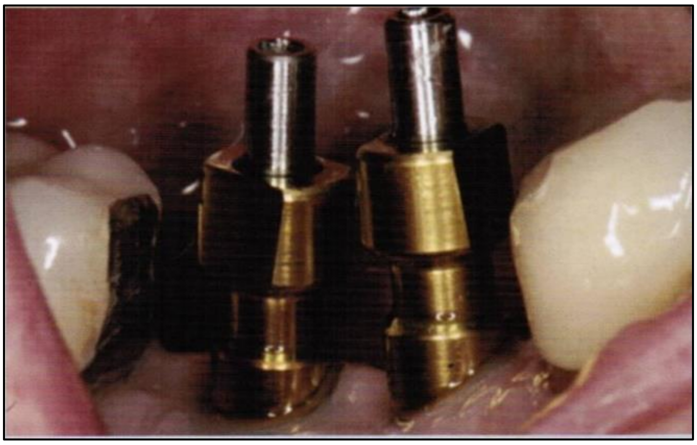

Figure 1.8: Impression abutment (Karunagaran et al., 2014).

It shows an open tray pick-up coping.

1.6.3 Metal or Plastic abutments

These abutments are used following exposure of the implant platform and prior to the final restoration. They are used in the provisional phase and help to customize the form, shade, soft tissue profile, and the occlusion prior to the definitive restoration (Karunagaram et al., 2013).

1.6.4 Stock abutments

Stock abutments (Fig 1.9) are prefabricated components that are screw retained and connected directly to the endosseous implant platform and generally made of prefabricated titanium. They consist of two pieces: the abutment and the abutment screw (Karunagaram et al., 2013).

Figure 1.9: Stock abutment (Karunagaran et al., 2014).

These abutments are used for the retention of a cemented prosthesis and are indicated for a single or multiple-implant prostheses. There are several common designs (e.g., straight, angled, esthetic), which vary based on the position and contours of the margins (Karunagaram et al., 2014; Shafie, 2014; Resnik and Misch, 2021).

These types of abutments should be modified in the lab or intra-orally so they can support a transitional crown or a final crown or bridge. The use of stock abutments requires very accurate implant placement in order to minimize reduction of the abutment (Karunagaram et al., 2014; Shafie, 2014; Resnik and Misch, 2021).

The advantages of these abutment are (Palmer et al., 2012; Resnik and Misch, 2021):

1. Simple to use, inexpensive and modifiable for the specific case.
2. Predictable fit and retention for crown.
3. Used in ‘straightforward’ cases where optimal space and implant orientation have been achieved.

The disadvantages of these abutments are (Palmer et al., 2012; Resnik and Misch, 2021):

1. Allow tissue show-through (i.e., darkness because of tissue translucency)
2. Associated with poorer tissue health.
3. Margin for crown does not follow gingival contour.
4. Not suited to very labially inclined implants.

1.6.4.1 Angulated abutment

These types of abutments (Fig 1.10) are incorporate in a 15 – 30 degree angulation in their design and made of titanium or its alloy or of ceramics (Misch, 2008, Kalpana, 2020).

They are used to overcome problems associated with implant angulation and their use should be limited to situations in which a facial or angled implant position precludes restoration without correction of the angulation. They are indicated for multiple implant restorations (Misch, 2008, Kalpana, 2020).

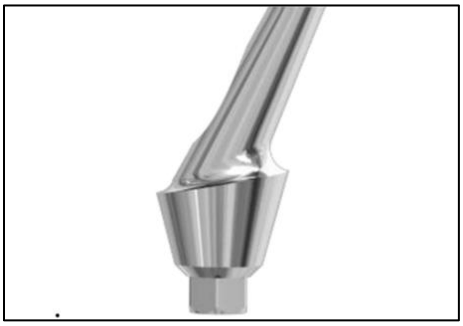

Figure 1.10: Angulated abutment (Karunagaran et al., 2014).

1.6.5 Custom abutments

Custom abutments (Fig 1.11) may be fabricated by using a castable abutment or through a CAD/CAM process. They may be produced from titanium, gold alloy, or milled zirconia with a titanium base (Karunagaram et al., 2014).

Figure 1.11: Custom abutment (Karunagaran et al., 2014).

They are used in situations when prosthetic corrections cannot be achieved by standard prefabricated implant parts. These situations include (Karunagaram et al., 2014; Shafie, 2014; Resnik and Misch, 2021):

1. Insufficient interocclusal restorative space.
2. An angle correction problem greater than 15°.
3. If the collar height needed is more than 1 mm greater than the largest collar height offered by the implant manufacturer.
4. If there is a need to replicate the original cross-sectional profile of the tooth in order to obtain an ideal emergence profile.
5. If there is a need to splint three or more implants.

There are three major techniques of customizing implant abutments, these include: Milling (starting from a bulky titanium abutment), manual modeling (creating a model for casting or scanning) and virtual modeling (designing a model in a virtual environment) (Shafie, 2014).

The advantages of custom abutments are (Karunagaram et al., 2014; Shafie, 2014; Resnik and Misch, 2021):

1. Better soft tissue health and correction of non-ideal implant placement.
2. Fabricated for each specific patient condition.

3. The subgingival crown margin position and contours can be extended only where necessary.
4. Allows for better hygiene and esthetic.
5. Improved facial esthetics.

The disadvantages of custom abutments are (Karunagaram et al., 2014; Shafie, 2014; Resnik and Misch, 2021):

1. An increased in laboratory cost.
2. Increased likelihood of screw loosening.

There are several factors required for manufacture of custom abutments, which are summarized in (Table 1.1).

Table 1.1: Factors requiring custom abutments (Karunagaran et al., 2014).

Criteria for Customization	Implication for Abutment Selection
Tissue Collar Height	Abutment margins should be supragingival in non-esthetic zones and slightly subgingival in the esthetic zones
Crown Height	Abutment height must not exceed the place available for crown materials
Interproximal Distance	Abutment width must be sufficient to support the crown but interproximal access to hygiene instruments must be sufficient
Implant Angulation	Abutment must counter an implant angulation
Esthetics	Margins should be subgingival in the esthetic zones, and the emergence profile must support the gingival tissue. A porcelain abutment may improve the esthetics.

1.6.5.1 UCLA-type abutment

The UCLA-type custom abutment is available in traditional plastic configurations, gold alloy, gold base with plastic sleeve, and in a titanium version for provisional restorations, and are available in single and multi-implant designs (Jokstadet et al., 2003; Ramos et al., 2014).

It is attached directly to the implant and provides a pattern for the creation of a screw retained veneered crown. This abutment is well-suited for sites with minimal thickness of soft tissue (Jokstadet et al., 2003; Ramos et al., 2014).

The properties of UCLA abutment (Ramos et al., 2014):

1. Precision machined.
2. 1 mm margin height.
3. Titanium Prosthetic Screw included with all abutments.
4. Optional Gold Prosthetic Screw.
5. Narrow chimney.
6. Micro-grooved finish for better wax retention, except waxing sleeve which is smooth.
7. Waxing Screw included with gold abutments.

1.6.5.2 CAD-CAM abutments

The CAD-CAM abutment are customized and fabricated from almost any material and to almost any angulation. To make this type of abutment the dentist makes an implant body impression (using a closed- or open-tray technique) that uses an impression transfer that engages the anti-rotational feature of the implant body (Resnik and Misch, 2021).

After the abutment is designed in the laboratory with the computer, it is milled or fabricated by digital technology (Resnik and Misch, 2021).

1.6.6 Over-denture abutment

Abutments for over denture (Fig 1.12) is made of male component; which is a ball head of the abutment screw and the female component; which is a plastic cap within denture base. The plastic cap uses rubber O-rings that fit over the abutment screw and provides retention (Prakash and Gupta, 2017).

In case of implant-supported overdenture, the abutment should be selected depending on the available inter-arch space. In case of bar-supported overdentures, the denture is retained by means of clip (Prakash and Gupta, 2017; Kalpana, 2020).

Figure 1.12: Over-denture abutment (Prakash and Gupta, 2017).

1.6.6.1 Ball abutment

It is a prefabricated abutment used for the retention of a tissue-supported overdenture (Fig 1.13). It is available in multiple heights for varying tissue collar. Ball abutments can be used with either O-ring attachments or nylon inserts (Shah et al., 2014).

Figure 1.13: Ball abutment (Shah et al., 2014).

1.6.6.2 Locator abutment

It is a prefabricated abutment available for securing the attachment of an implant-supported overdenture or even a partial denture (Figure 1.14). It is available in multiple heights for varying tissue levels along with nylon (male) attachments that are color-coded for variable retention and divergence (Shah et al., 2014).

Figure 1.14: Locator abutment (Shah et al., 2014).

1.6.7 Multi-unit abutment (MUA)

MUA are abutments designed to be used in multiple-implant where the entire arch is replaced in edentulous or partially edentulous arches. Multi-unit abutments are available in a range of angulations and sizes dependent on several factors, including the type of dental implant and the intra-oral environment of the patient (Edvard and Janeva, 2020).

The two main categories of MUA are straight or angled (0°, 17°, 30° and 45°) (Meng et al. 2007; Edvard and Janeva, 2020).

The quartet of MUA's is known as an All-on-4 restoration, and there are also restorations known as All-on-6 and All-on-8, which employ six and eight implants, respectively (Meng et al. 2007).

The advantages of using multi-unit abutments clearance (Meng et al. 2007; Edvard and Janeva, 2020):

1. Easier and more predictable seating of the final restoration.

2. Reduced stress translated into the restorative system.
3. The angulation correction can be determined in the patient’s mouth.
4. Use for patient who have any misalignment teeth or uneven bone in the jaw.
5. Evaluate the available vertical.

The disadvantage of using multi-unit abutments clearance (Meng et al. 2007; Edvard and Janeva, 2020):

1. Tiny screw and very difficult maneuvering of abutment.
2. Unique handle designed.
3. Present additional cost.

1.7 Abutment-implant connection

The abutments connect to the implants with an implant platform that is either internally or externally connected and the internal connections are used more commonly. If this antirational component is on implant platform on which abutment is seated, it is external hex, if this feature extends within the implant body it is internal hex (Karunagaram et al., 2013; Benakatti et al., 2021).

The interface between the implant and the crown is one of the most important aspects of implant dentistry. Which is a critical factor in determining the durability and success of two-piece dental implant-supported prostheses. The two-piece implant system consists of an endosteal part, the implant, and the mucosal part which is the abutment. The mucosal portion is usually attached to the endosteal part after the osseointegration has taken place (Implant, 2023).

1.7.1 External connection

This design offers a great variety of restorative options due to the interchangeability of abutments among the manufacturers. The initial 0.7 mm external connection, being short in length, provided only limited screw engagement which served the purpose of coupling and acted as a torque transfer device (Shafie and White, 2014; Shah et al., 2014; Benakatti et al., 2021).

This design had several drawbacks owing to limited height which makes it ineffective when excessive off axial load was applied. Several complications like abutment screw loosening, fracture, and micromotion at the interface; these make it unsuitable for other applications like fixed partial dentures and single tooth replacements (Shafie and White, 2014; Shah et al., 2014; Benakatti et al., 2021).

Advantages of External connection (Shafie, 2014):

1. Data on long-term follow-up is available.
2. Compatible with various implant systems.

Disadvantage of External connection (Shafie, 2014):

1. A-High proportion of screw loosening.
2. High proportion of rotational misfit.
3. Less aesthetically pleasing outcomes.
4. Inadequate microbiological seal.

1.7.2 Internal connection

The internal hex design allows implant cover screw to be held in level with the top of the fixture at stage one surgery when compared to the external hex design, which is required to hold the cover screw that seat slightly above the level of the fixture (Shafie and White, 2014; Shah et al., 2014; Benakatti et al., 2021).

Advantages of the internal connection (Shafie, 2014):

1. Less screw loosening.
2. Better esthetics.
3. Improved microbial seal.
4. Better joint strength.
5. More platform switching options.

Disadvantages of the internal connection (Shafie, 2014):

1. The weakest link is the bone rather than the retaining prosthetic screw.
2. There is less historical literature on internal connections than external connections.

1.8 Retention of dental implant prosthesis

Three main categories of implant abutments are described (Fig 1.15), according to the method by which the prosthesis or superstructure is retained to the abutment, which are abutment for screw retention, abutment for cement retention and abutment for attachment (Shafie, 2014).

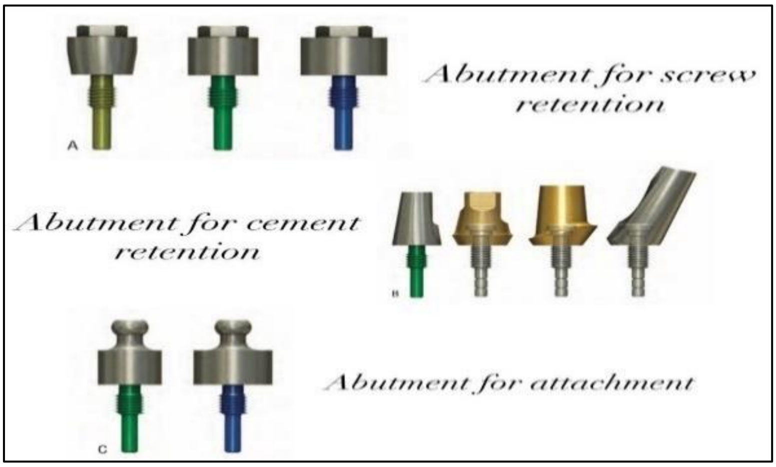

Figure 1.15: Categories of an implant abutment (Hupp et al., 2018).

1.8.1 Abutment for screw retention

Screw retention abutments utilize a screw to secure the prosthesis to the abutment, providing excellent retention and stability. The screw retention abutment is particularly useful in cases where the prosthesis may need to be replaced or adjusted over time. One of the significant characteristics of screw retention abutments is their stability. They provide a secure fit, preventing any unwanted movement of the prosthesis (Resnik and Misch, 2021).

The advantage of screw-retained restorations (Shah et al., 2014):

1. Retrieval is possible.
2. Can be used in limited interocclusal space.
3. Better tissue response.

The disadvantages of Screw-retained restorations (Shah et al., 2014):

1. Ideal implant position required.
2. Restorations should be passive.
3. Possible occlusal interference.
4. Porcelain fractures.
5. Screw loosening and fractures.
6. Difficult access.
7. Relatively expensive because of components.

1.8.2 Abutment for cement retention

An abutment for cement retention uses dental cement to retain the prosthesis or superstructure (Shah et al., 2014).

The advantage of cement retention (Shah et al., 2014):

1. Flexible implant positioning.
2. Occlusion controlled in a precise way.

3. Easy access.
4. Relatively less expensive.
5. Easy provisionalization.

The disadvantage of cement retention (Shah et al., 2014):

1. Retrieval is unpredictable.
2. Minimum 4 mm of abutment height needed. Excess cement leads to peri-implantitis and poor tissue response.

1.8.3 Abutment for attachment retention

An abutment for attachment uses an attachment device to retain a removable prosthesis (e.g., an O-ring attachment) (Misch, 2008; Hupp et al., 2018; Misch, 2021;).

1.9 Assessment criteria for abutment design and selection

1.9.1 Evaluation of restorative space

Abutment height must not exceed the space available for the restoration. Examine the distance from the crest of the alveolar ridge or the implant platform to the proposed occlusal plane in the posterior region and the incisal edge in the anterior region (Karunagaran et al., 2014).

1.9.2 Evaluation of soft and hard tissue

An assessment of the supporting tissues is critical in implant treatment planning. In most occasions, the proposed implant site presents itself with deficiencies due to trauma, tooth loss, or periodontal disease. This loss in architecture translates to both hard and soft tissue deficiencies (Fig 1.16) (Karunagaran et al., 2014).

Figure 1.16: Alveolar ridge defects (Karunagaran et al., 2014).

The position of the definitive restoration therefore should be assessed in relation to these existing deficiencies. This is achieved both clinically and radiographically. The quality and quantity of bone, vertical, horizontal, and combined ridge defects should be examined and identified relative to the planned restorative position (Karunagaran et al., 2014).

These sites may require corrective grafting procedures or implant site development to have the implant platform placed in an ideal position for the definitive restoration (Seibert, 1991).

1.9.3 Evaluation of implant platform location

Abutment margins should be supragingival in non-esthetic zones and slightly subgingival in the esthetic zone. Incorrect implant placement can lead to both esthetic and prosthetic complications. Positional problems may result from an incorrect placement of the implant platform in mesiodistal, apicocoronal, or buccolingual directions (Karunagaran et al., 2014).

Mesiodistal positional errors should not exceed 3 mm from the intended prosthetic position, to prevent unreasonable esthetic and functional challenges (Fig 1.17A). Apico-coronal positional errors should not lead to exposure of the metal collar and implant platform, (Fig 1.17B). Buccolingual positional errors should not result in a ridge lap design in the definitive prosthesis, as this invariably makes oral hygiene almost impossible for the patient. (Fig 1.17C) (Karunagaran et al., 2014).

Figure 1.17: Incorrect placement of the implant platform (Karunagaran et al., 2014). (A) Incorrect mesiodistal placements, (B) Incorrect apico-coronal placements, (C) Incorrect buccolingual placements.

1.9.4 Evaluation of internal engaging / nonengaging connection

The “engaging” is referred to an anti-rotational component that prevents the turning of the abutment at the implant interface, thereby preserving the integrity of the preload on the abutment screw interface. The type of prosthetic connection is established in conjunction with the type of implant platform to be used, whether it be at the bone level or the tissue level (Fig 1.18) (Karunagaran et al., 2014).

Figure 1.18: Platform connection (Karunagaran et al., 2014).

The depth of penetration of the abutment within the fixture of the implant should be known, as well as the intimacy of fit between the walls of the abutment and the internal surface of the implant fixture. Non engaging implant connections were proposed to overcome the challenge of accurately seating internally indexed abutment, especially when using multiple abutments (Karunagaran et al., 2014).

1.9.5 Evaluation of platform switch

The implant platform is the area or the interface at which the implant and the abutment come together. Platform diameters can vary and can range from 3 to 6 mm; depending on the implant system used. All platforms are divided into groups: narrow (3 mm), regular (4 mm), and wide (5–6 mm) (Karunagaran et al., 2014).

The width of the implant platform chosen is often indicated by the width of the tooth being restored. When placing an implant adjacent to another implant, a greater distance has been recommended, with a minimum space of 3 mm (Karunagaran et al., 2014).

When these "platform-switched" components were utilized, there was less change in crestal bone height surrounding the implants than when the implants were restored in the traditional way (Lazzara and Porter, 2006).

1.9.6 Evaluation of tissue collar height

A measurement of the soft tissue sulcular depth from the surface of the implant platform to the free gingival margin should be reflected in the design of the abutment (Giglio, 1999; Karunagaran et al., 2014).

Abutment marginal placement should ideally follow the anatomy of the gingival margin on the buccal and mesial should be placed at or 1 mm below the gingival margin. Palatal and distal abutment margins may be placed at the gingival crest or 0.5mm below the crest based on operator preference (Giglio, 1999; Karunagaran et al., 2014).

1.9.7 Evaluation of emergence profile

The emergence of an implant restoration is dependent on implant location in three-dimensional space and the width of the implant platform. Anatomically, teeth are ovoid in cross section at the level of the cemnto-enamel junction (CEJ). Alternatively, implants have circular platforms, and this difficulties for the dentist in creating a natural tooth profile as it emerges from the soft tissue (Karunagaran et al., 2014).

Ideally, the placement of the implant platform should be established 3 mm below the CEJ of the adjacent teeth to provide the correct emergence of the restoration out of its socket. If this can be established a prefabricated abutment may be used to construct the definitive prosthesis. If soft tissue depths exceed 3 mm, then customization may become necessary to follow the existing gingival topography (Karunagaran et al., 2014).

The need for customized abutment may also be beneficial in more challenging situations, especially where anterior restorations are being planned in patients with excessive gingival displays and esthetic challenges keratinized tissues can be customized by a variety of methods (Fig 1.19) (Karunagaran et al., 2014).

The emergence profile may be modified either by a direct or an indirect technique prior to definitive abutment selection. Direct techniques involve customization intraorally, while the indirect technique involves customization within the laboratory setting (Karunagaran et al., 2014).

Figure 1.19: Emergency profile customization (Karunagaran et al., 2014).

1.9.8 Evaluation of implant angulation

Improper alignment of implants compromises both esthetics and function due to the unfavorable positioning of the screw access opening. Ideal access openings should be centrally placed (Fig 1.20). The dentist may prefer to fabricate a custom abutment to produce a more ideal abutment design, thereby providing more control in the position of the definitive restoration (Karunagaran et al., 2014).

Angulations less than 15° are slight and may usually be corrected by modification of straight standard prefabricated abutments. Angulations between 15° and 20° may require the use of angle correcting prefabricated abutments, while an angulation discrepancy greater than 20° will usually require a custom abutment (Karunagaran et al., 2014).

Figure 1.20: Ideal implant location (Karunagaran et al., 2014).

1.9.9 Implant abutment esthetics and function

An ideal abutment should be durable and able to undergo functional loads without a risk of deformation and fracture. Within the anterior region, the abutment should ideally be tooth colored and allow soft tissue coloration (Karunagaran et al., 2014).

In sites of thin gingival biotypes, the implant abutment can often show through at the cervical extent of the tissue surface, producing an unesthetic result (Karunagaran et al., 2014).

In such instances, three options are available in abutment design: a zirconium abutment, a titanium nitride coated abutment, or a titanium abutment with pink gingival porcelain to mask the color show through the gingiva (Karunagaran et al., 2014).

Titanium abutments are the standard, but now use titanium-reinforced zirconia abutments and zirconium or alumina abutments, which are often the choice if restorations are planned within the anterior esthetic zone to produce more satisfactory results (Karunagaran et al., 2014).

1.10 Complication associated with dental implant abutment

1.10.1 Abutment screw loosening

Screw loosening can be attributed to an unwanted gap or movement at the implant-abutment interface and micro roughness between the implant and abutment (Jörnéus et al., 1992; Winkler et al., 2003; Implant, 2023).

The quantity of settling is influenced by the initial surface roughness, surface hardness, tightening torque and loading forces. This causes two types of clinical problems. The first arises during the manufacture of implant prostheses, when the settling that occurs creates a vertical position fluctuation. (Dailey et al., 2009).

The second is screw loosening, which happens when the oral cavity is subjected to a functional load. Implant systems with external hexagonal connectors have relatively minimal abutment settling during tightening because to the flat top platform (Merz et al., 2000).

Whilst a certain degree of settling happens for implants with a tapered conical internal connection during tightening, the length of a screw and the wedge effect of abutment expanded when the tightening force was elevated in internal conical connections (Merz et al., 2000).

1.10.2 Abutment screw fracture

Screw fracture is an uncommon (range from 0.5% to 8%) but challenging technical complication in implant-retained restorations and may occur due to bruxism, unfavorable superstructure, overloading, malfunction, premature occlusal contacts, metal fatigue after screw loosening, and component misfit (Canpolat et al., 2013).

A fractured abutment screw must be removed without damage to the implant body to be replaced by a new abutment, so the implant will still be able to retain the prosthesis. The success of removal depends on the location of the screws (Canpolat et al., 2013).

If fracture occurs above the head of the implant, the screw can be removed successfully with hemostats; however, if fracture occurs below the head of the implant, other special removal systems can use (Canpolat et al., 2013).

1.10.3 Abutment fracture

The risk of fracture abutment has been reported most for zirconia abutments because is a brittle material and cannot bear tension. When zirconia abutments fracture, new abutments and crowns are needed, which costs both time and money (Gou et al., 2019).

In addition, the removal of fractured abutments may damage the inner configurations of implants or even lead to implant losses. In particular, the difficulty in direct visualization makes removal of abutments more intractable if implants are located under the alveolar bone for enhancing the esthetics of anterior teeth (Gou et al., 2019).

1.10.4 Bacterial adhesion and peri-implantitis

As a result of an excessive gap between the implant and the abutment, bacteria can penetrate and adhere to the interface. This can lead to implant failure as a result of peri-implantitis (Diana, 2018).

CHAPTER 2

CONCLUSION

CHAPTER 2 CONCLUSION

In conclusion, dental implant abutments are an essential component of the implant system, playing a critical role in supporting the implant restoration and providing stability and functionality. Abutments come in different shapes, sizes, and materials, each designed to suit specific clinical situations.

Threaded abutments are a popular option for their ability to screw onto the implant fixture, providing a secure and stable connection. However, non-threaded abutments offer advantages in certain clinical situations, such as cement-retained restorations and esthetic cases.

The choice of abutment depends on several factors, including implant location, restoration type, patient's oral health status, and esthetic demands. Careful planning, assessment, and communication between the dental team and the patient are necessary to determine the most suitable abutment type and design.

Proper abutment selection, placement, and maintenance are crucial for the long-term success of dental implants. Complications such as abutment screw loosening, implant fracture, peri-implantitis, and implant failure can occur if abutments are not properly managed. Regular follow-up and maintenance visits, including radiographic and clinical assessments, can help detect and manage any complications early on.

Advancements in technology and materials have led to the development of new abutment designs and techniques, such as angled and customized abutments, which offer improved outcomes and esthetics.

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