

IMPLANT ABUTMENTS- Revisited

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ABSTRACT: With the high rate of implant success for edentulous, partially edentulous, and single-tooth restorations the concept of osseointegration and implant therapy is now a highly predictable treatment modality. Several implant abutment designs are constantly evolving to meet esthetic and functional requirements. This review aims to discuss different categories of implant abutments according to their designs, mechanics of implant abutment connection, method of abutments fabrication, and the materials from which abutments are made.

KEYWORDS: implant abutments, CAD/CAM ,UCLA abutments, implant Attachments

INTRODUCTION

The ideal goal of modern dentistry is to restore the patient to normal form, function, comfort, esthetics, and health. An implant can be defined as A prosthetic device made of alloplastic material (s) implanted into the oral tissues beneath the mucosal or/and/ periosteal layer, and on/or within the bone to provide retention and support for a fixed or removable dental prosthesis. An implant can be of various types - endosteal implants, subperiosteal implants and zygomatic implants. An endosteal implant consists of two main parts, the implant body and the prosthetic component.

An endosteal implant can be one piece or two piece implant, one piece implant is one in which the implant and abutment consist of one unit. Two piece implant consists of a bone level implant and abutment as two separate units.

As the osseointegrated implants were developed to treat partially edentulous patient, there was a strong need to introduce several modifications for the transmucosal abutments. Wide ranges of abutment designs and materials are available to achieve optimal results in various clinical cases.²

An abutment is a component that is intermediate between the implant and the restoration and is retained to the implant by a screw¹. An abutment is a connecting unit between the bone level implant and prosthetic unit.

Dental implant abutment is defined as a component of a dental implant that is used to support and/ or retain any fixed or removable dental prosthesis (Acc. GPT9)

A dental implant with three tier system includes three individual parts like crown, abutment and implant. A dental implant with two tier systems includes two individual parts like crown and abutment form a single part and the implant is a separate part or abutment and implant makes a single part and crown is individual in dental implant system. Figure 1 shows separate form about tier system of dental implant³

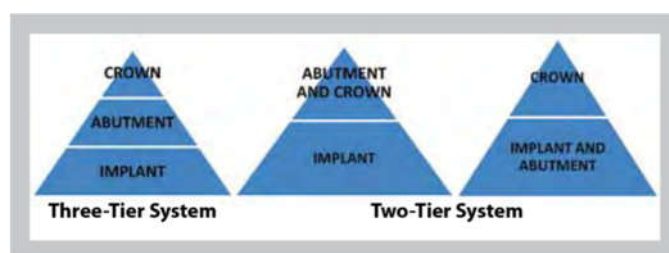


Fig1

CLASSIFICATION OF ABUTMENT ⁴

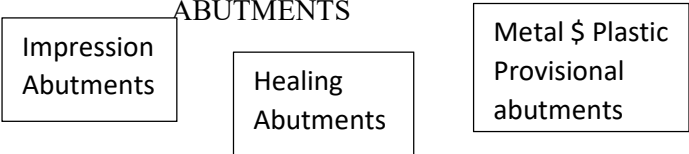
ABUTMENTS CAN BE CLASSIFIED AS,⁵

According to,

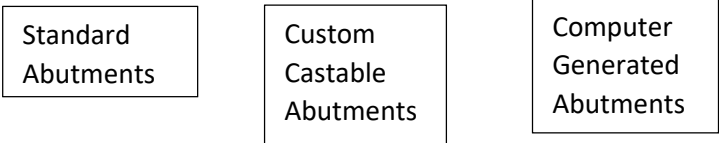
- 1) duration of treatment
- 2) Abutment connection
- 3) type of material
- 4) type of retention
- 5) method of fabrication

1) According to duration of treatment

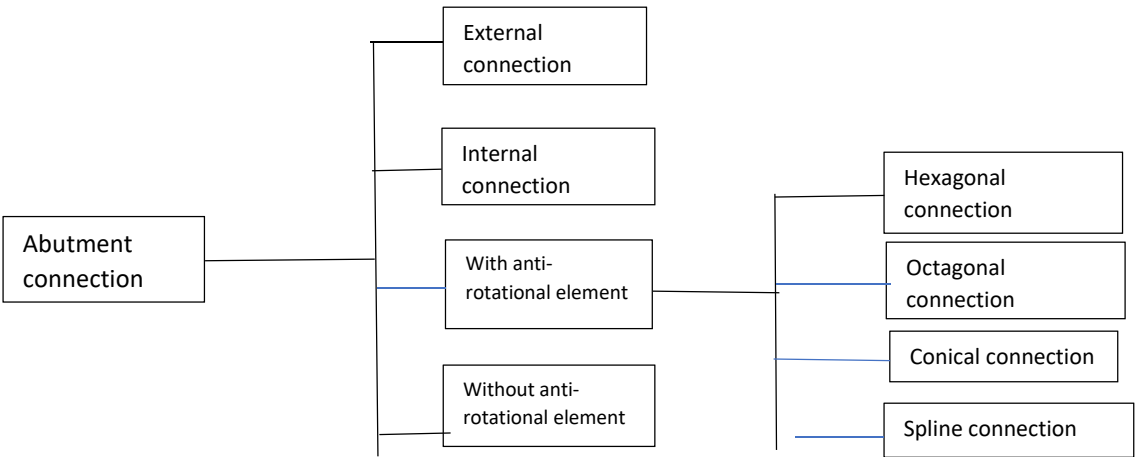
TEMPORARY ABUTMENTS
ABUTMENTS



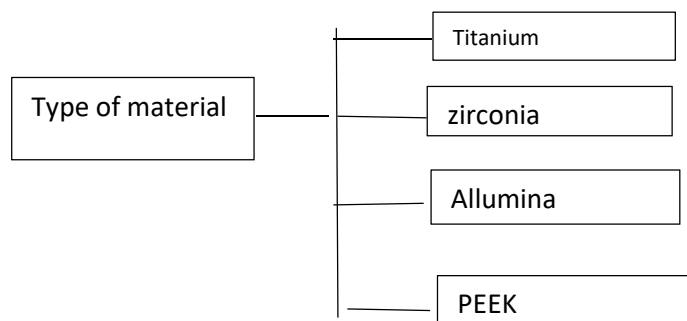
DEFINITIVE



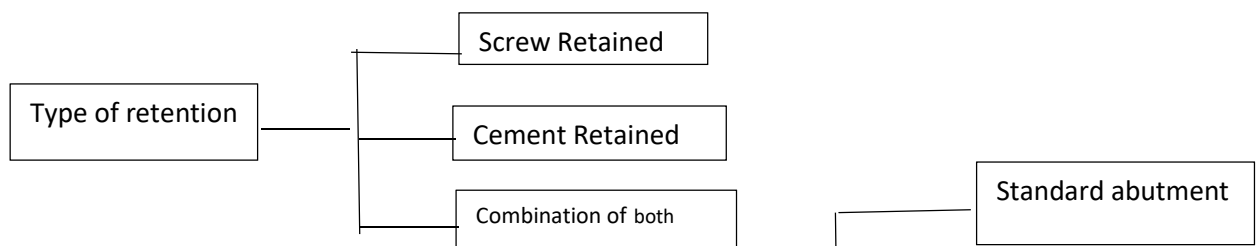
2) According to Abutment connection



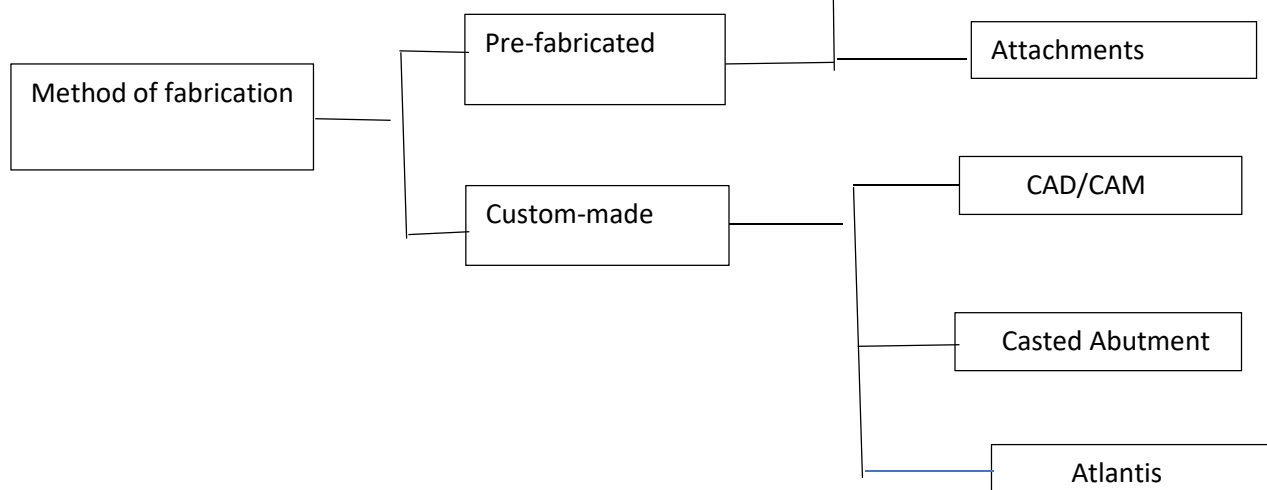
3) According to type of material



4) According to the type of retention



5) According to method of fabrication



I) According to duration of treatment

Temporary Abutment-

Temporary abutments are an essential component in prosthetic dentistry procedures. They allow the tissue around the implant to heal while also providing an attachment point for the crown, bridge, or

other dental restoration. Following implant osseointegration with the surrounding bone, the temporary abutment may be removed for a permanent abutment to take its place. Temporary abutments come in a variety of designs, such as snap abutments and slim abutments, for convenient placement and easy removal. The type of temporary abutment selected for use in a dental procedure will depend upon the kind of procedure, the patient's oral anatomy, and the type of prosthesis required.

IMPRESSION ABUTMENT-

An abutment impression coping typically comes in two different types — open tray impression coping and closed tray impression coping. For single-unit partially edentulous patients, closed tray and open tray impression copings can be used interchangeably depending upon the clinician's preference. Multiple implants that will be splinted in either partially or fully edentulous patients, *open tray* impression copings will be more accurate. It has also been shown that *splinting* the impression copings in the mouth (ie. with resin) can improve the accuracy as well. If the implants are malaligned it is advisable to use *open tray* impression copings since the misalignment of the implants may lock the impression in the mouth if *closed tray* impression copings are used because of their lack of draw.

HEALING ABUTMENTS-

A healing abutment, also known as a healing cap or gingival former, can help promote soft and hard tissue healing around an implant. It promotes soft and hard tissue healing around an implant. The healing cap also protects the main part of the implant from plaque and debris accumulations. It is often fitted on top of the implant. It is slightly wider than the implant to help shape the gumline and improve the emergence profile

PROVISIONAL ABUTMENTS-

Provisional abutment helps in tissue management to form a simple, esthetic and soft tissue management during the healing period .Abutment contour can be individually adapted, prepped or milled for the final abutment selection.

Provisional abutments can also be used as impression copings for closed tray impressions.

II) According to Implant-Abutment connection-





Fig2.1

fig2.2

External Hex Connection

The external hex design was the first to be used in the manufacturing of dental implants. It was originally 0.7 mm in height and was used to help screw the implant fixture into the prepared osteotomy. When the dental implants began to be used in replacing a single-missing tooth, the external hex with some improved quality was used to prevent rotation of the abutment under loading. The external hex connection is still in use as it is suitable for the two-piece implant placement method, has an antirotational mechanism, and is compatible with different implant systems⁶ (fig2.1)

TYPES OF EXTERNAL HEX CONNECTON

Tapered External Hexagon

This system consisted of an eternal hex with a 1.5° taper. The main advantage of this system was a significant reduction in the chances of implant rotation, thereby minimizing screw loosening.

External Octagon – this system consists of an eight-sided external connection which a 45° rotation while the abutment was placed over the fixture. However, this system could not get much popular as it was not compatible with angled abutments.

External Spline – this implant system contains 6 spline teeth which project outward from the implant body, which fit into 6 grooves present between the projections from the opposite abutments. An advantage associated with this system is decreased screw loosening and minimal rotational movement.

Spline Connection-

Splines are fin to groove anti rotational design • The Spline implant connection (SulzerCalcitek) consists of 6 external parallel keys (splines) alternating with 6 grooves • Consist of six external components which protrude 1mm from implant and are matched to a female embedded in an abutment base

Advantages of the external hex connection

- Long-term follow-up data are available
- Compatibility among multiple implant systems
- Solutions to complications are found throughout the literature due to their extensive use

-

Disadvantages of the external hex connection

- Higher prevalence of screw loosening
- Higher prevalence of rotational misfit
- Less esthetic results
- Inadequate microbial seal

Internal Hex Connection

External connection modifications have reduced the problem of screw loosening. However, overcoming the esthetic and microbial seal issues warranted a novel approach to the design of the abutment connection(fig2.2). Rather than modify the existing abutment, a new concept was developed – that of the internal connection. This shift revolutionized the market. Now numerous variations of internal connections are available from the different implant manufacturers.

TYPES OF INTERNAL HEX (fig3)

6 Point Internal Hex – this system has a 1.2mm deep hex which is present inside the implant body. This system allows positioning of the abutment over the implant at every rotation of 60°. (fig3.a)

12 Point Double Internal Hex –

this system contains a double internal hex which is recessed 4mm deep into the implant body. This system provides abutment positioning over the implant after every rotation of 30°. Advantages of this system include improved stress distribution and suitability for use with angled abutments. (fig 3.b)

Internal Cylindrical Hex – this system has a 5mm deep hex inside the implant body. This system offers the advantage of enhanced implant-abutment joint stability as it resists bending forces.

Internal Octagonal Hex – This system is similar to the external octagonal hex. However, instead of containing an external hex, this system contains an eight-sided internal geometry. The internal octagonal hex allows orientation of the abutment over the implant at 4 different positions.

Internal Spline Connection – this system has a triangular geometry. The Trichannel implant system introduced by Nobel Biocare consisted of three lateral channels which projected from the implant abutment into the implant body, as a means to offer an anti-rotational feature. It allows 3 positions to place the abutment over the implant.

Morse Taper/ Locking Taper – this system has a conical projection which extends from the abutment and fits lightly into a conical recess inside the implant body. An advantageous feature of this system is that the mechanical friction between the external wall of the abutment and the implant wall offers cold-welded stability.

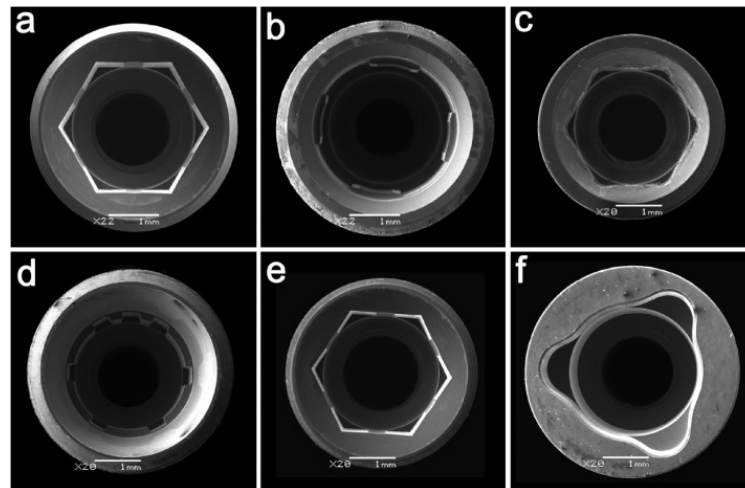


fig3

Advantages of the internal connection

- Less screw loosening
- Better esthetics
- Improved microbial seal
- Better joint strength
- More platform switching options

Disadvantages of the internal connection

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

III) According to types of material

,Titanium abutments have been reported to cause reflection and grayish coloration of the mucosa around the implant . Inorder to overcome this disadvantage abutments are made from full ceramics to provide optimum esthetics when used in conjunction with full ceramic curtain restorations, reducing shading in soft tissue⁷

. Yttrium-stabilized tetragonal zirconia polycrystals (Y-TZPs),PEEK have begun to be used as abutment materials due to their durability and biocompatibility and Esthetics(fig7)

Many companies that produce custom abutments for individuals can produce zirconia abutments in various color alternatives prepared beforehand by sintering in different color solutions or in different colors of zirconia blocks,

PEEK and Zirconia abutments were introduced into dental implantology as an alternative to the metal abutments. Due to its biocompatibility, colour and its mechanical properties, Zirconia is a well suitable replacement for metal abutment.

IV) According to the type of retention(fig4)

Abutment for screw retention

Abutment for cement retention

Abutment for attachment

Implant retained prosthesis can be screw retained, cement retained, or a combination of both (cemented prosthesis with lingual or palatal fastening screws)

- **Abutment for screw retention**- an abutment that needs screw to retain the prosthesis,

Advantages-

- Better passivity
- Easier to obtain esthetics
- Fewer porcelain fractures due to occlusal surface integrity
- Less fatigue
- Manipulation in posterior region easier with cement
- Loosen less often as compared to that of screws

Disadvantages-

- Difficult to retrieve unless soft cements are used.
- Gingival retraction may be needed
- When permanent cements are used evaluation and maintenance may sometimes be difficult



Abutment for cement retention- an abutment which needs dental cement to retain suprastructures

1. Single unit or one piece abutment - does not engage antirotational hex but fits flush with the implant platform.
2. Two piece abutment - Has one component to engage antirotational hex of implant body and the other component to fixate the abutment and implant body together.

ADVANTAGES

- Low profile of retention
- Less momentum of force
- No risk of cement in the sulcus
- Easily retrievable.

DISADVANTAGES

- Loosening of the screws
- Difficulty to obtain passivity

- Difficult to obtain esthetics
- Greater chances of porcelain fracture
- Access to posterior regions difficult
- risk of aspiration.

Based on Attachments

It is a type of abutment which needs an attachment device such as magnet O-ring to retain a removable prosthesis.

O-ring attachment (fig4)

Bar Attachment(fig5)

Locator Attachment (fig6)

Magnetic Attachment(fig7)



Fig 5



Fig 6

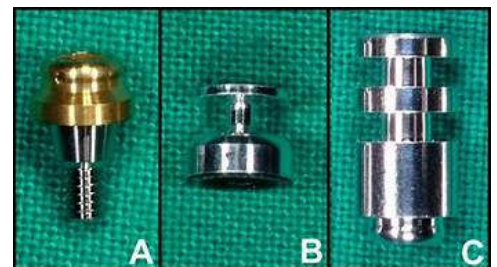


Fig 7

RECENT ADVANCES

CAD/CAM ABUTMENTS-

Titanium is milled using CAD/CAM technology to create and customize abutment instead of casting metal

CAD/ CAM Technology has introduced methods of fabricating the final impression with digital methods of impression making and scanning followed by milling out prefabricated metal alloys to produce a restoration that is more precise than the traditional casting methods.(fig8)

Advantages-

- Implant specific abutment can be milled according to the required angulation , collar height etc
- Ideal for optimised function , esthetics and simplicity

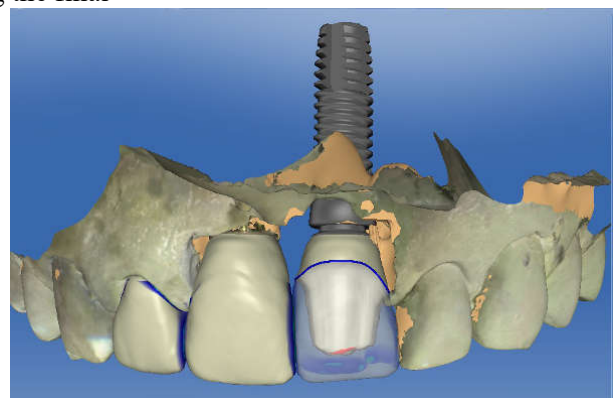


Fig 9

Some of the CAD/ CAM Systems Commonly are,

1. Noble Procera
2. Bella TekEndocde
3. Straumann CARES
4. Atlantisparallel – can be prepared by Direct method

Ucla Abutments

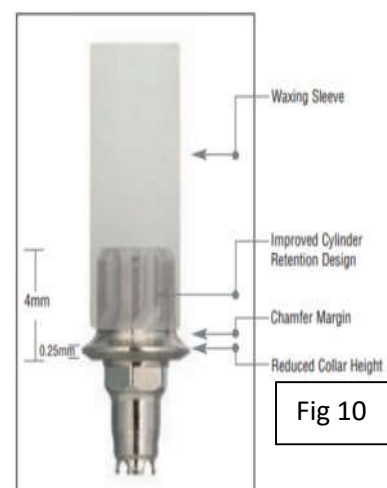
The UCLA-Type Abutment is attached directly to the implant. It provides a pattern for the creation of a screw retained veneered crown. This abutment is well suited for minimum thickness soft tissues. It is available in various forms^{8 (fig9)}

- Precision machined.
- 1mm margin height.
- Titanium Prosthetic Screw included with all abutments
- Narrow chimney.
- Micro - grooved finish for better wax retention, except waxing sleeve which is
- Waxing Screw included with gold abutments

V)According to method of Fabrication,⁶

Pre- Fabricated Abutments-

The prefabricated abutment is prepared by the manufacturer from different materials and provides a connection between the implant and the restoration, with different platform width, length, and gingival output profile. These abutments can be fabricated from titanium or its alloy, titanium with titanium nitride coating, or ceramic (alumina or zirconia) materials. They may also be angled or straight. The pre-angled abutment has varied angulations provided by manufacturers, usually 15 and 25 degrees off-axis (fig10)



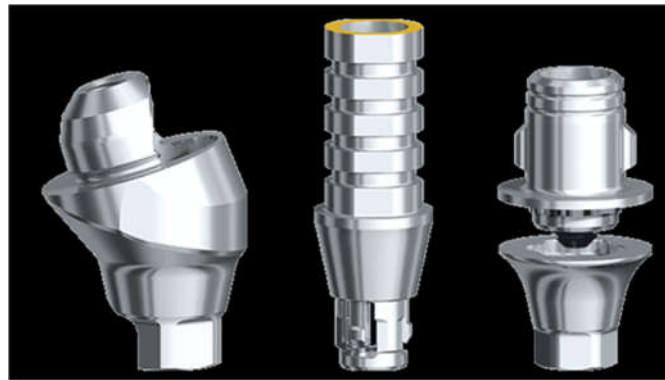


Fig10

PRE-FABRICATED can be further classified into Straight Abutments Or Angled Abutments

Straight/Standard Abutments-

It is an abutment whose body is parallel to the long axis of the implant. Indicated for replacing single tooth for large prosthesis upto full arch, implant borne reconstructions. (fig11)



Fig11

Angled Abutments-

The availability of the bone determines the position of the implants that may produce angulation or non parallel implants. They are available in different angulations lie 15deg ,20deg ,35deg. An abutment whose body is not parallel to the long axis of the implant. It is utilized when the implant is at a different inclination in relation to the proposed prosthesis available in angulations from 10 -30 degrees(fig12)

- improved esthetics
- To correct path of insertion
- Increase in angle

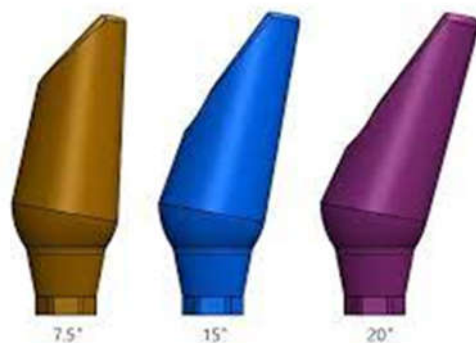


fig 12

Custom-Made Abutments-

The custom abutments are preferred for the esthetic and function in the anterior restorations. In the posterior region, it has been reported that the use of custom abutments is more successful than prefabricated abutments because of the small diameter implants due to insufficient bone mass, chewing forces in these regions are high and gingivae are wider

Titanium abutments are considered as a 'gold standard' because of their clinical success rates and improved physical properties



Fig 13

MULTIUNIT ABUTMENTS-

When multiple implants are misaligned in the posterior quadrants or during restoration of a complete arch multi-unit (MU) abutments, straight or angulated could be used to overcome the misalignment by moving the implant internal connection to a taper external connection and render the restoration screw-retained. By using such abutments, the occlusal stress will be moved from the implant screw to the MU abutment small screw.

The advantages of using multi-unit abutments is having a much easier and more predictable seating of the final restoration ,creating reduced stress translated into the restorative system due to the passive nature of the seating process of multi-unit abutments.

GUIDELINES FOR SELECTION OF ABUTMENTS

1. Depth of Soft Tissue

Vertical height from implant head to the gingival margin is measured with periodontal measuring probe 6 following Stage 2 surgery. Labial margin of abutment is atleast 1mm subgingival. The choice of abutment is therefore decided upon the available gingival margin.⁸

2. ORIENTATION

Ideally implant is placed close to the long axis of missing tooth (through incisal tip or just palatally). Small degree of labial angulation is only required if the implant orientation is off angle

leads to excessively contoured labial surface. Porcelain surface

3. INTEROCCLUSAL SPACE

Interocclusal space corresponds to the vertical distance between the superior surface of the implant and the opposing dentition in maximum intercuspation. This interocclusal space is the total height available for the abutment plus the restoration. At least 2.8 mm of interocclusal space is necessary to restore an implant because of the limitations in commercially available abutments.

4. EMERGENCE PROFILE⁹

Emergence profile allows gradual transition from implant head and the key for this is the interdental papilla. The need of atleast 3mm of vertical space from implant head to gingival margin and it allows gradual transition from implant head causing the emergence

Emergence profile can be determined depending on various factors

Contouring of subgingival abutment component. –

Position of the contact point of the restoration. –

Height of the bony crest at the neighbouring teeth.

CLINICAL RECOMMENDATION –

During abutment selection on the basis of implant-abutment connections, clinician should consider the topography of bone, available soft tissue characteristics, force component such as rotational, the prosthetic components required particularly for aesthetic purpose, and single-implant restoration. Finally, clinician can make a decision based on personnel choice.

DISCUSSION –

A meticulous clinical examination including the diagnostic mounting in maximum intercuspation would facilitate recording the interocclusal space. This will later facilitate the selection of prefabricated or custommade abutment. Hence, selection is made at initial treatment planning phase under individual clinical need.

Implant dentistry can provide a range of additional abutment locations

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MULTI UNIT ABUTMENTS RECOMMENDED IN PROSTHETIC AND SURGICAL

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UDC: 616.314-089.843 65

FIG 1- IMPLANT TIER SYSTEM

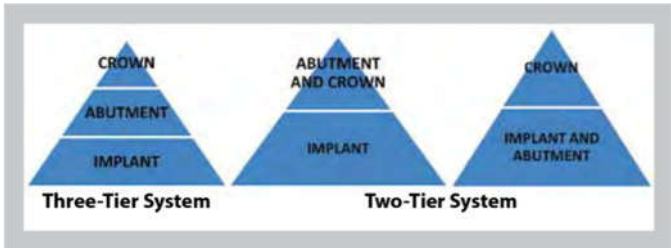


FIG 2.1 -EXTERNAL HEX

FIG 2.2- INTERNAL HEX



FIG 3- TYPES OF INTERNAL HEX

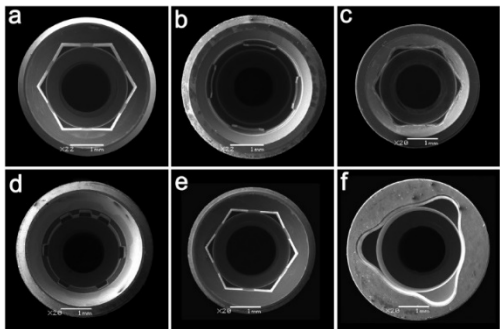


FIG 4-



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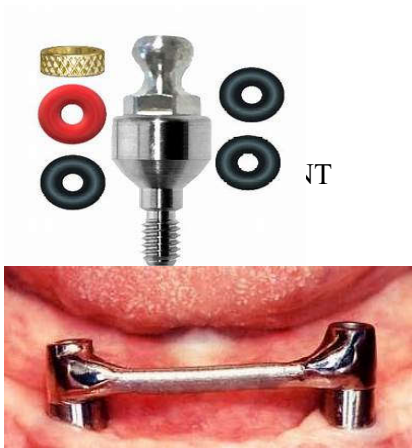


FIG7-LOCATOR ATTCHMENT

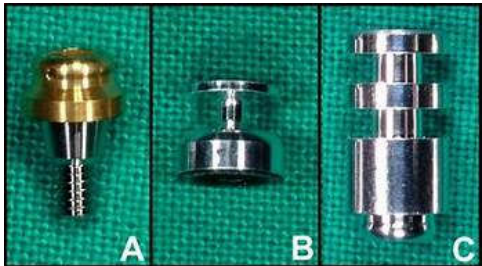


FIG 8- MAGNETIC ATTCHMENT



FIG9- LOCATOR ATTCHMENT

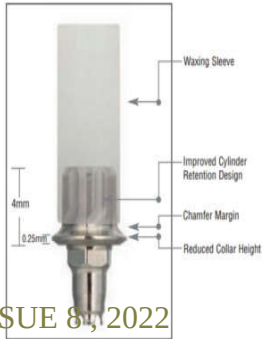


FIG 10- PRE-FABRICATED ABUTMENTS



FIG11- STRAIGHT ABUTMENTS



FIG12- ANGLED ABUTMENTS

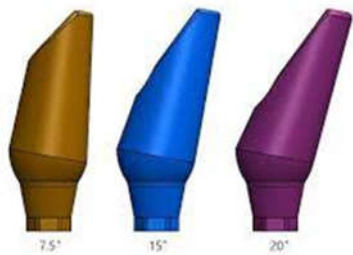


FIG 13- CUSTOM MADE ABUTMENTS

