A Review of Implant Abutments - Abutment Classification to Aid Prosthetic Selection

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ABSTRACT

With an increase in the availability of implant restorative components, the selection of an appropriate implant abutment for a given clinical situation has become more challenging. This article describes a classification system that will help the practitioner understand the different implant abutments available and therefore be able to understand the selection of abutments for single and multiple unit fixed implant prosthesis.

Introduction

The dental implant is rapidly becoming a cornerstone in the current practice of dentistry. The predictability of dental implants as a treatment modality has sustained a considerable amount of research and investment in producing more durable restorations. The development of implant surfaces, surgical protocols and prosthetic components have helped to provide the dentist with the required armamentarium to aid in planning, placing and restoring missing dentition.[1]

An abutment is a component that is intermediate between the implant and the restoration and is retained to the implant by a screw or locking taper. Abutments can usually be separated from the implant, but in some cases they may form part of the implant itself. Additionally, not all implant restorations require abutments. In these cases, the crown is fabricated to be attached directly to the implant platform. Abutments effectively help form the restorative part of the implant prosthesis. The abutment provides the retention, support, stability and optimal position for the final restoration.

The integration of the final restoration to the implant platform can either be planned as a three-tier or two-tier system, as outlined in **Figure 1**. A three-tier system incorporates three separate component, the implant, the abutment and the crown. A two-tier system incorporates two separate components, the abutment and the crown form a single unit and the implant is a separate component or conversely, the implant and the abutment form a single unit and the crown is separate.

Implant Tier System

Most abutments are retained into the implant platform by a screw (Screw-retained) and the final crown can be screw-retained directly onto the abutment (Three-Tier system) or directly onto the implant platform (Two-Tier system). Alternatively, the crown can be cemented as in a conventional crown and bridge protocol (Cement-retained) onto the abutment which is retained to the implant by a screw (Three-Tier system). There are also current implant systems that enable the abutment to be locked or friction fit into the implant, without a screw or cement method of retention.

The availability of a vast number of prosthetic components has left many dentists confused at the selection process of these components and in particular the indications for the use of such components. This article will outline a method to classify appropriate abutments for implant restorations. This will hopefully serve to enhance understanding of the best available options for the treatment of our patients.

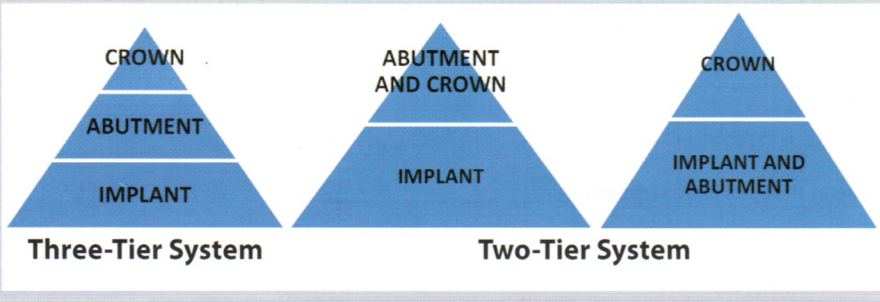
When considering restorative options, the clinician should consider the following protocol to help with the process of implant crown fabrication.

1. Diagnostic wax up or Trial tooth set up
2. Fabrication of Radiographic and Surgical template
3. Surgical Phase and placement
4. Provisional Phase and soft tissue contouring
5. Impression making
6. Jaw Relation record
7. Prosthetic Abutment selection and Crown Design
8. Prosthesis delivery

Types of Abutment

Implant abutments are generally either custom made in a dental laboratory or prefabricated from implant manufacturers.[2] Custom abutments require the dentist to make an implant or fixture level impression of the implant platform with the aid of an impression coping. A prefabricated abutment is

Figure 1 - Implant Tier System



machine made by the manufacturer, and it may be selected directly by an implant or fixture level impression or it may be directly adapted to an existing platform and impressed as a conventional crown. Custom abutments can be costly as they are commonly used in situations when prosthetic corrections with the standard prefabricated implant parts are not possible.

Prefabricated abutments are less expensive and easy to use, but they do have some limitations and there are instances where such abutments are contraindicated.[3] Situations that may require custom abutments may include: (1) if there is insufficient interocclusal restorative space, (2) if there is 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, and finally (5) if there is a need to splint three or more implants. In these situations customizing the implant abutment may be more beneficial as the standard stock abutments might not be able to accommodate the corrected changes needed. **Figure 2** illustrates a customized abutment to help correct incorrect implant angulations.

Abutments can be divided into two forms: temporary abutments and definitive abutments. These abutments connect to the implants with an implant platform that is either internally or externally connected. The type of connection seems to have an influence on the incidence of prosthetic failures, and internal connections are used more commonly.[4]

Figure 2 - Customized Lingual Set Screw Abutment

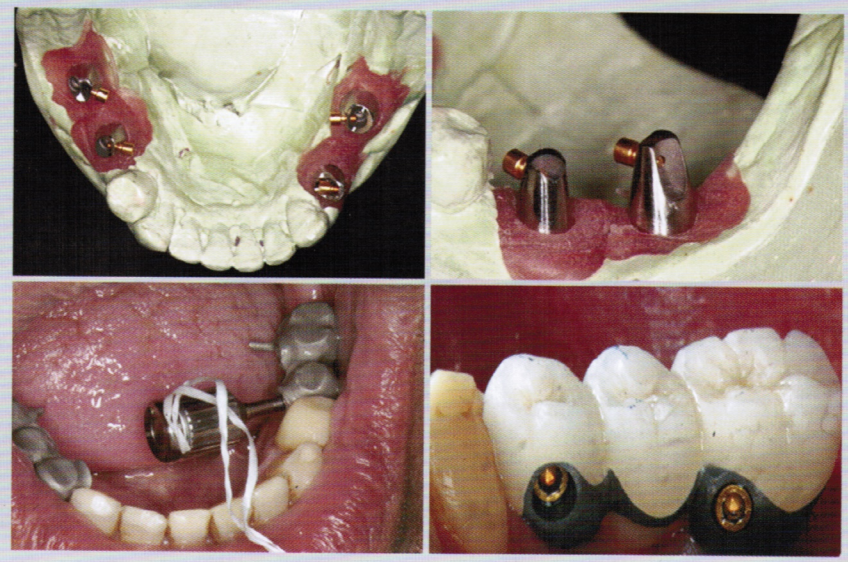
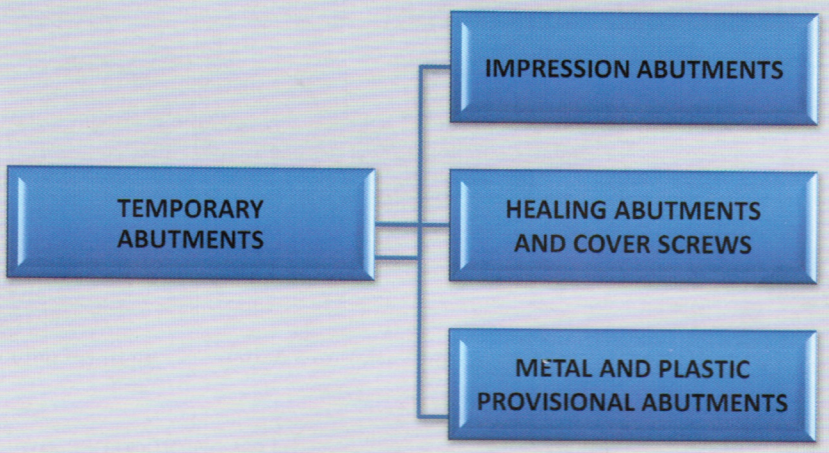


Figure 3 - Temporary Abutment Classification



Temporary Abutments

Temporary abutments are usually produced in a stock prefabricated fashion, in that they are machine premade. They include impression abutments, healing abutments and metal or plastic provisional abutments, as illustrated in **Figure 3**. The clinician has the option to use them as is or to try to customize them as needed to establish tooth and gingival contours. Many of these abutments are modified to establish tissue contours especially in the esthetic region. These abutments help create the emergence profile, esthetic, phonetic boundaries, the position and the shade of the desired final restoration. It can be used to help establish the final form of the definitive restoration. Insufficient time spent on this stage can often lead to an inadequate restoration and unsatisfied patients.

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. **Table 1** illustrates the differences between the two as well as the indications for their uses. **Figure 4** shows an open tray pick-up coping.

Healing Abutments

The abutments illustrated in **Figure 5** are used to cover the implant platform following surgical placement of the implant and to prevent tissue and bone growth into the implant body. It also helps establish epithelization of the tissue and prevents influx of fluids from the oral cavity into the implant body. They can be used as a one-stage or two-stage protocol. A one-stage surgical protocol allows the healing abutment to traverse the soft tissue in a transmucosal fashion and is exposed during the healing phase. This allows the dentist access directly to the implant

platform without involving a second stage of surgery. A two-stage protocol involves covering the entire implant platform, sealed with a cover screw, under the soft tissue and requires a second surgery to expose the implant.

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. They can be metal titanium, ceramic zirconia or acrylic PEEK (polyetheretherketone). The abutments can also be engaging or non-engaging at their interfaces to the implant surface, which can provide the dentist with the option of using them in single or multi-unit situations. Abutments are also fabricated in a standard stock round, stock anatomical profile which follows the patient's natural gingival profile. These abutments can also be customized by the technician (indirect lab fabrication) or by the dentist (direct intraoral fabrication).

Figure 4 - Impression Abutments Nobel Biocare™

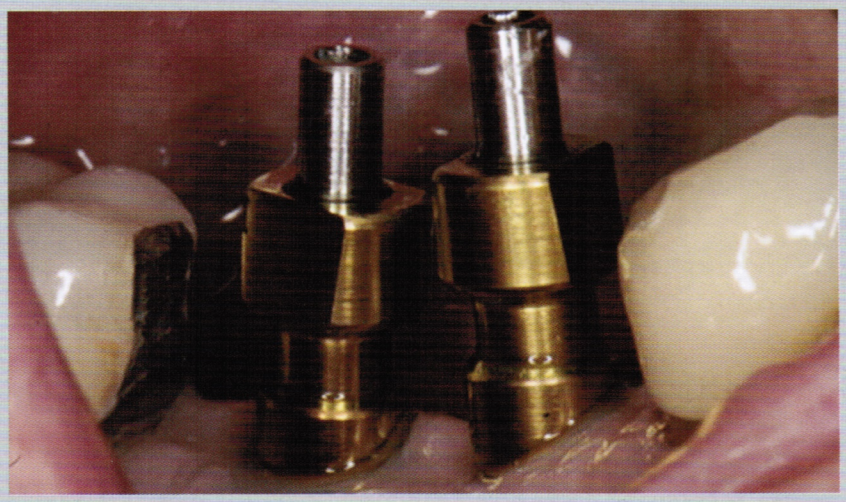


Table 1 - Differences between Closed Tray and Open Tray Impression Copings

Factors	Transfer Coping	Pick up coping
Interarch Space	Less space needed for impression, Suitable for posterior areas	More space required to accommodate the larger copings
Tray Preparation	No preparation necessary	Must be perforated to accommodate the coping
Splinting Multiple Copings	Not possible	Possible
Precision of Impression	Possible distortion because the copings have to be reinserted into the impression	Less distortion because the coping remains in the impression. Splinting the copings have no value on accuracy

Definitive Abutments

Permanent abutments are used for the final restoration and will remain in place definitively. The dentist has a choice during the final fabrication to use either a standard prefabricated, custom castable or computer generated abutment, as illustrated in **Figure 6**. The choice is dictated by the individual clinical situation, clinical experience level and patient preference.

Standard Stock Abutments

Stock abutments are pre-machined abutments that can be modified by the dentist or the laboratory technologist. Implant companies have recently manufactured stock abutments to try to cut down the preparation time by the dentist. This has included abutments which are shaped more to the natural contours of the crown and are termed esthetic abutments. In addition these abutments also come in a variety of angulations to deal with implant positional problems. Standard stock abutments vary according to the manufacturer and they come as fixed and removable abutment restorations each having their own indications. Fixed abutments include Snappy abutments, Multi-unit abutments, Esthetic abutments, Procera abutments, Gold adapt abutments and single tooth abutments. Removable abutments are Locator, GPS abutments, ERA, Mini ERA, Ball attachments, ZAG etc.

Custom Castable Abutments

Customized abutments, illustrated in **Figure 7**, are more commonly used in situations where stock abutments cannot be used to correct extreme angulation problems or to deal with corrective abutment designs to accommodate proper coping and crown designs. In addition to the previously mentioned criteria, **Table 2** also illustrates some of the situations that may require the selection of custom castable abutments. These abutments are waxed by the

technician to the required contours and custom fit into the restorative space. They tend to be quite labor intensive and costly. They utilize UCLA, gold adapt, or cast to abutments for the casting process.

Computer Generated Abutments

CAD/CAM technology was incorporated into the production of implant abutments and frameworks in the 1980s.[5] These abutments are fundamentally changing present restorative protocols. Traditional techniques relied on the accuracy of the processes of impression materials, gypsum products, waxing crowns, investing and casting with alloys at high temperatures. These produce avenues for inaccuracies to develop. CAD/CAM has introduced methods of fabricating the final impression with digital methods of impression making and scanning and then milling out prefabricated metal alloys to produce a restoration that is more precise than the traditional casting methods. When considering CAD/CAM implant abutments there are several systems available on the market currently, but they all seem to stem from the following protocol:[6]

a. Scannable Abutments (Scan bodies)
b. Prepable Scanned Abutments
c. Virtual Assisted Design
d. Robotic Analog Design

Implant manufacturers have developed unique proprietary systems. Some of the common systems are outlined below:

Figure 5 - Healing Abutments

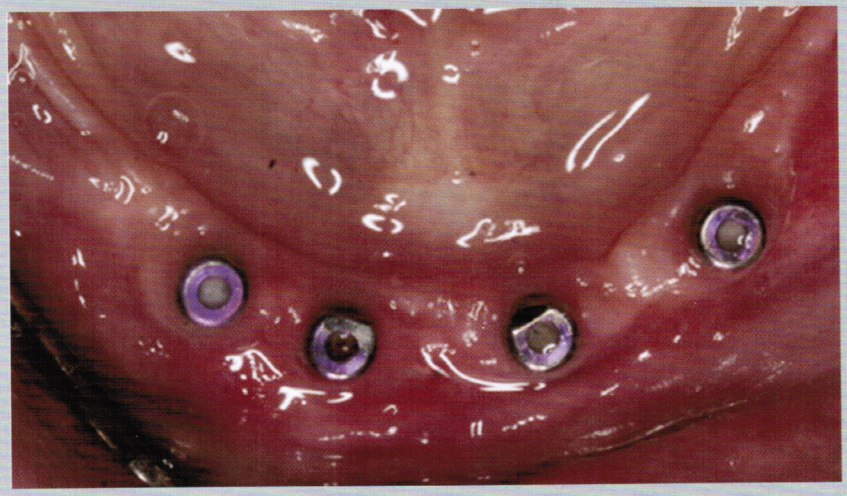
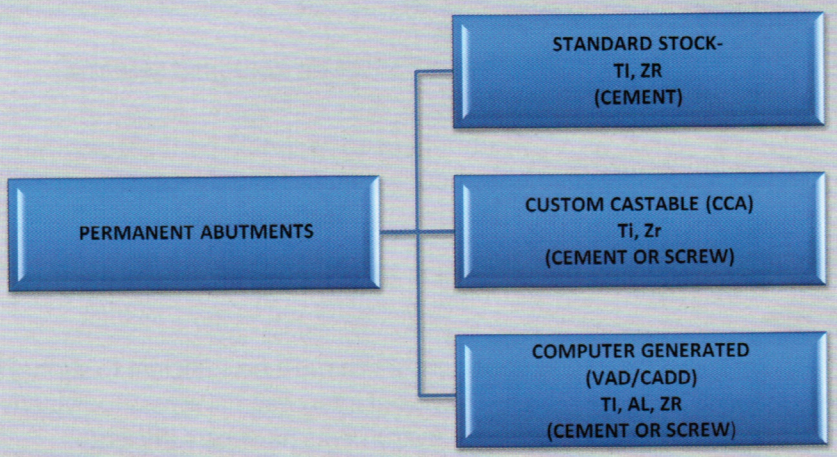


Figure 6 - Definitive Abutment Classification



1) **NobelProcera®** (Nobel Biocare USA, LLC, Yorba Linda, CA) provides abutments in titanium, zirconia or alumina. Fixture level impressions are made and a master cast is produced. This cast can then produce the abutment in two modes.[6] The cast can be scanned and the abutment can be designed in an entirely 3D fashion by computer software. Another method would allow a preprepared base cylinder to be placed on the cast and then waxed. This wax-up is then transferred to the scanner. This information for both systems is then sent to the Nobel Biocare facility for CAM and sent back as either a metal or ceramic coping.

2) **Bella Tek® Endocde®** (BIOMED 3i, Palm Beach Gardens, FL) is a robotic analog design. This system uses an impression of the healing abutment to design and fabricate the final abutment. These healing abutments come in a two-piece system which has notches on its occlusal surface which act as codes that the computer can scan and translate into implant abutment designs.[7] The scanner can extract information about the position of the hex, the diameter of the implant platform, the collar height and then exact 3D placement of the implant. This then allows CAD and CAM fabrication.

3) **Straumann® CARES®** (Straumann, USA, Andover, MA) makes two-types of abutments: zirconium dioxide and titanium. In this system an implant level impression is made and then duplicate model of the master cast is fabricated. This is called the scan model and is made of a type of plaster that is scanable.[6] A scan body is also attached to the implant analog prior to the scan to delineate implant position. The custom abutment is then designed CAD on screen to the contours needed and transmitted to the Straumann center. Etkon is another system that uses the same principles of waxing up onto a plastic cylinder which is then removed and scanned.

4) **Atlantis™**, (DENTPSLY, International, York, PA) abutments

can be fabricated in titanium or gold shaded titanium or zirconium. The gold-shaded abutments aid in covering up the silver color of the titanium and provide a more esthetic value to the patient. Thissystem can be used with any of the available implant systems and begins with a fixture level impression and then the diagnostic cast and the master cast are scanned. The abutment is then designed on software termed virtual assisted design (VAD) and milled. Guidelines for the design are incorporated into the prescription, including:

a. Implant information: Tooth number, implant brand and platform diameter
b. Abutment material: Titanium, gold shaded titanium, zirconia and Gemini
c. Margin design: Chamfer, Shoulder
d. Retentive Surface: Yes or no
e. Healing Abutment diameter
f. Margin Position: Free gingival margin (FGM) to abutment or implant platform to abutment
g. Emergence profile options: Full anatomic, Contour soft tissue, Support tissue or no tissue displacement

Figure 7 - Customized Abutments

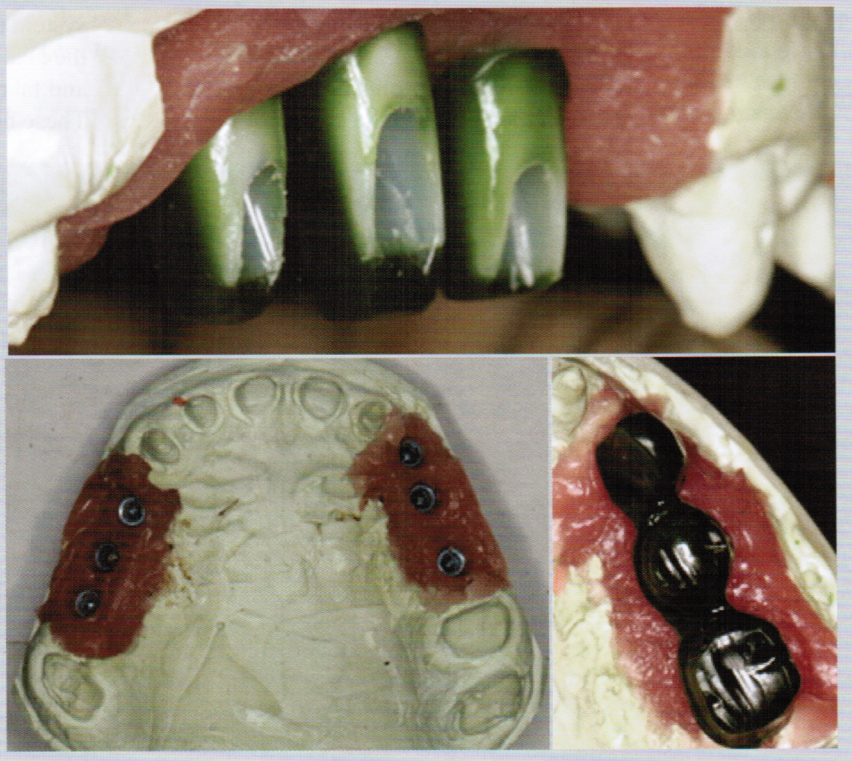


Table 2 - Factors Requiring Customized Abutments

Criteria for Customization	Implication for abutment selection
Tissue Collar Height	Abutment margins should be supragingival in nonesthetic zones and slightly subgingival in the esthetic zone
Crown Height	Abutment height must not exceed the space available for the 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	Margin should be subgingival in the esthetic zone, and the emergence profile must support the gingival tissues. A porcelain abutment may improve the esthetics

Conclusion

Understanding abutment classification is just one step in the process of creating the ideal restorative prosthesis. This article presents a classification system to outline a method for abutment selection. The treatment, however remains the same and will invariably involve correct treatment planning, decision making and sequencing of treatment that will ensure a successful end result.

Disclosure:
The authors did not report any disclosures.

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1. When considering custom abutments, which of the following is TRUE:
   a. They require an impression of the implant platform
   b. They require an impression of the abutment
   c. They are used in situations where the prosthetic corrections cannot be made by prefabricated abutments
   d. Both a and c are true

2. Custom abutments can correct which of the following:
   a. Insufficient interocclusal restorative space
   b. Angle correction problems greater than 15°
   c. Need to replicate the original cross sectional profile of the tooth
   d. To obtain the correct emergence profile as it exits the implant platform
   e. All statements are true

3. Which of the following is NOT a temporary abutment:
   a. Impression abutments
   b. Healing abutments
   c. Standard Stock abutments
   d. Metal or plastic provisional abutments

4. When considering transfer copings, which of the following are FALSE:
   a. Less space is needed for the impression and it is suitable for posterior areas
   b. No preparation of the tray is necessary
   c. Splinting of the copings is possible
   d. Possible distortion, as the coping have to be reinserted into the impression

5. When considering 3i CAD/CAM BellaTek® Encode® abutments which of the following designs does it incorporate:
   a. Scan Bodies
   b. Prepable, Scanned abutments
   c. Virtually assisted design
   d. Robotic Analog design

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