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Prosthetic Components In Implant Dentistry

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Introduction

Edentulism is visible as a bodily impairment that significantly impacts dietary and mental buildup of the patient. Among various options available for rehabilitation, implant therapy has recently achieved more attention. The success rate of implants has improved with the introduction of endo-osseous osseointegrated implants. Implants are the nearest equivalent to natural tooth. [1]

An optimal esthetic and functioning restoration is considered to be a combination of visually pleasing prosthesis with adequate surrounding peri-implant tissue.[2] Earlier, most implants failed due to surgically planned implant prosthesis, where no importance to prosthesis was given.

With the introduction of prosthetically driven implant placement, the success rates have improved.[3]The functional behaviour of implant supported prosthesis is important. To prevent failure due to function, following should be considered:[4]

1. Prosthetic components
2. Type of prosthesis- cement or screw retained
3. Occlusion and occlusal adjustment
4. Biomechanical factors
5. Surgical factors

The use of prosthetic components depends on factors such as diameter, height, function, available space, etc. Limited knowledge of the above mentioned factors result in prosthetic failure, even if the implant is placed in a surgically correct position.[5]

The present article shall be focused on different prosthetic components, their importance and their use in detail. Prosthetic components in light:

1. Healing abutments
2. Cover screw
3. Transfer coping
4. Abutments
5. Abutment screws
6. Implant prosthesis

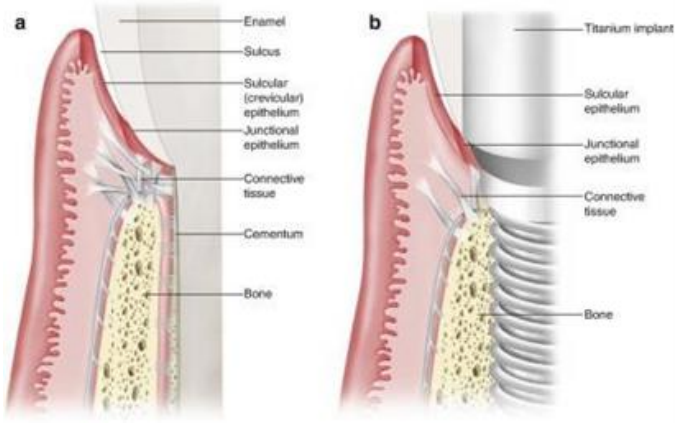
Healing Abutments, Peri-Implant Soft Tissue, and Gingival Biotype

Soft tissue around implants holds fundamental importance, not just for aesthetics but also function of the implant prosthesis. Soft tissue architecture is influenced by underlying bone and connective tissue. It is of utmost importance to consider gingival biotype and biological width in order to achieve functioning and aesthetically pleasing implant prosthesis.

The soft tissue around implant is less vascular and more fragile when compared to natural tooth. The presence of Sharpey's fibres along the zone of biological width around the natural tooth provides a stable and strong foundation. This is absent in the soft tissue that surrounds the implant, hence, more fragile. [6]

The connection of fibres around the natural tooth also enables it to transverse forces better and withstand the forces better.

On the contrary, fibres around the implant run parallel to the implant surface, therefore , the foundation is not that stable to hold the place and in the initial healing stages, the implant is highly prone to bone and soft tissue loss.



On the contrary, fibres around the implant run parallel to the implant surface, therefore , the foundation is not that stable to hold the place and in the initial healing stages, the implant is highly prone to bone and soft tissue loss.

In a study by Kawara et al [7] , it was concluded that- the epithelium attaches to implant by hemidesmosome like connections and is very thin. The connective tissue was a scar like tissue and was very fragile. The tissue was less vascularized and hence could have a negative impact against bacterial invasion.[8]

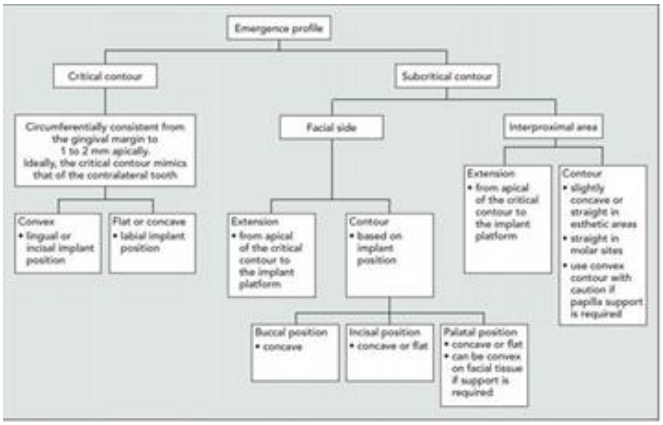
Gingival Biotype: with the advent of literature, it is now understood that gingival biotype also has a role in the success of implant prosthesis. Different biotypes behave differently under similar clinical conditions. The thin gingival biotype is said to have delicate and highly scalloped, translucent gingival tissue. Usually presents with gingival recession. On the other hand, thick gingival biotype has heavy periodontium, flat gingival contour and presents itself as formation of periodontal pockets and loss of attachment when subjected to undue forces. [11, 9,10]

Emergence Profile: emergence profile represents the contour of the implant abutment/crown complex as it emerges from the implant restorative platform and peri-implant soft tissue. [12]

Sub-critical contour is analogous to tooth root surface above the osseous crest. The sub-critical contour should

provide gradual and harmonious transition from implant platform to the critical contour. [12]

Critical contour represented by cemento-enamel junction (CEJ) or the transition zone between tooth root surface and anatomical crown.



HEALING ABUTMENT**:** the aim is to as closely replicate the emergence of a natural tooth in the implant prosthesis. Cylindrical shapes of the implant prosthetic components should be altered to more anatomical contours. There are four ways to prosthetically accomplish soft contour sculpting, use of: [12]

- Healing abutment
- Provisional restoration
- Custom abutment
- Definitive prosthesis

Healing abutment is titanium, cylindrical in form and is available in various lengths and widths. There are two types of healing abutments: standard healing abutment and customized healing abutment. Healing abutments are placed in the second stage surgery after the implant bone interface is formed.

Healing abutments are available as standard healing abutment and customized healing abutment.

Standard Healing abutments are manufactured in two most common collar heights – 3mm and 5mm and various widths , commonly narrow platform(NP) that is a 3.5mm platform , regular platform(RP) that is 4.1mm and wide platform(WP) that is 5.0mm. The values are different for different systems.

Certain systems like NobelReplace [TM] provides color coding for platform identification.

Straumann ® healing abutments are available as tissue level and tapered effect abutments. Available as straight abutments or abutments with a bevel to aid in contour development.

Whereas all Straumann bone level narrow connection (NC) are yellow colour coded. These are cone shaped and bottle neck shaped with different platform width and heights.

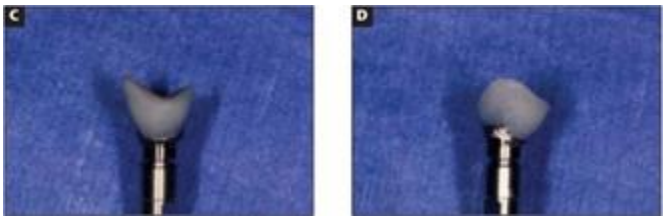
Customized Healing Abutments: prefabricated healing abutments are unlikely to yield ideal results in every case. In esthetic zones, it is preferable to use custom abutments to yield good esthetic results.

Silicone custom abutment: Study by Daniel 2004 [14] showed that emergence profile was better achieved by customized healing abutments made of silicone. Silicone custom abutments also overcome the disadvantages of acrylic abutments.

Plastic custom abutment: Harsha kumar et al [15] customized using a plastic abutment and modified it

using inlay wax to stimulate the anatomy of tooth. The final pattern was casted in titanium.

Composite custom abutment: Jim et al [16] prepared a temporary abutment using light cure flowable composite. This enables esthetic emergence profile.



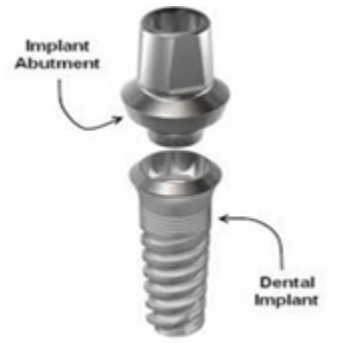
Healing abutments can be mono-block or two piece components.

Mono-block prosthetic healing abutments

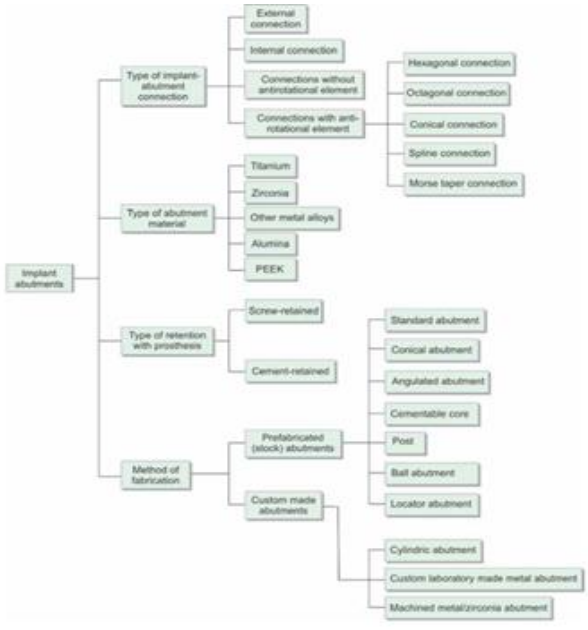
Two-piece healing abutment

Coded Healing Abutments: [17] used along with CAD/CAM , the system consists of coded healing abutment that has 3 notches on the occlusal surface. The laser optical center in the machining center interprets these codes. The digital information is transferred to a solid model. It recognizes the codes to determine the hex position, depth of implant position, and platform diameter. The designed abutment is milled and a cement retained restoration is fabricated over the abutment.

Abutments: Abutment if the portion of implant that supports or retains a prosthesis or implant superstructure. [18]



Implant abutments can be classified based on type of connection, material used, and method of fabrication. Abutment connection can be external connection, internal connection and with or without anti-rotational element. Implant abutments materials most commonly used are titanium, PEEK, zirconia, etc.[19]



Crown cemented onto a prefabricated titanium abutment. UCLA abutments were later introduced in 1988, these made it possible to use custom cast metal components that can be screwed to the implant. [20]

Studies have reported that metal abutments cause a blue-grey discolouration/ reflection from the peri-implant gingival tissue, which is unesthetic in patients with high smile line or gummy smile. This led to development of zirconia abutments. Zirconia abutments offered biological advantage such as less bacterial adhesion and more biocompatibility.

Abutment Selection: selection of implant abutment depends on factors such as implant diameter, emergence profile, implant orientation, interocclusal distance, peri-implant tissues, etc. [21]

Dental implant platforms are available in various diameters, ranging from 3mm to 6mm. these are selected based on size of teeth that is to be replaced. The diameter of restorative platforms may be the same size, or wider or narrower than the implants.

Malpositioning of implants, is one of the common reasons to make use of custom abutments. If the implant is placed in the planned position and the angulation is favourable, pre-fabricated abutments can be used. [21]

Pre-machined abutments can be used when the inter-occlusal distance is between 5mm-9mm. if the distance is more than 10mm, pre-machined abutments don't suffice and custom made abutments are necessary to provide adequate retention and resistance form.

Abutments are available as temporary or definitive, which further can be straight or angulated, screw or cement retained.[22] prefabricated abutments are available as modifiable and non-modifiable abutments. Custom made abutments on the other hand are made of plastic, wax pattern with/without machined interface ring. UCLA plastic abutments are examples of such abutments.[23]

Abutment Attachment

Attachments are the prosthetic components are considered as pillars of implant supported overdentures. Attachments such as studs, bar and clips, magnets and telescopic attachments are available. These permit movement during function and insertion and removal from mouth. [24]

Attachments further are resilient or non-resilient type, are used according to the amount of space available. Stud attachments are available as extra-radicular and intra-radicular.[84] Ball attachments, Locaters, O-ring attachments, etc are most commonly used. [25,26]

Impression Posts or Copings

Accuracy of the impression enables long term success of implant supported prosthesis. The transfer of clinical conditions, implant angulation and position is an important step. This transfer can be done in two ways: pickup or transfer. [27]

A direct transfer coping usually consists of two pieces, a hollow component and a long central screw. Whereas, indirect transfer coping uses material that has elastic properties. [6]

Indirect transfer coping is used for closed impression technique, where the transfer coping is screwed onto the implant body and impression is made. After the removal of impression, the coping and removed from mouth and positioned onto the impression.[28]

Direct transfer coping on the other hand is used where multiple implants have been placed or implants placed are not parallel and are oriented in different directions.

ANALOGUE: is something that is analogous or similar to implant. Is used in fabrication of the master cast to replicate the retentive portion of implant body or abutment. Impressions can be transferred using a closed tray or open tray technique. [29]

These copings when used for cases with multiple implant placement, can be splinted in order to increase the accuracy of replication and therefore reduced micro-movement.[30] The splinting can be performed using resin and floss, orthodontic wires, acrylic bars, polyvinyl siloxane and polyether. [31]

Implant Restoration- Cement Vs Screw Retained

Implant prosthesis can be screw retained or cement retained to implant fixtures.[32] this decision of choice of prosthesis is an important one and has an impact on the prognosis of restoration. The choice depends on various factors that include retention, retrievability, esthetics and clinical performance.

Cement retained implant prosthesis are the most common type of restoration. Cement retained restorations are advantageous in case of improperly aligned implants, lack of screw access hole, tilted implants, etc. cement retained restorations have the advantage of being versatile esthetically, passive fit and easier control of occlusion. [33,34-37]

Conversely, screw retained implant prosthesis were used for full-arch prosthesis. These have advantage of more predictable retrievability, require minimum inter-occlusal space and are easier to remove for maintenance of hygiene.

Provisionalization And Gingival Molding

Provisional phase is essential to facilitate soft tissue conditioning and lead to peri-implant mucosa and emergence profile development , that is in harmony with the neighbouring dentition. Screw retained provisionals have advantage over cemented provisional.

Screw Retained Prosthesis- Newer Developments

Not always is it possible to place the implants parallel to one another. Certain prosthetic components have been introduced that compensate for and redirect angulation of prosthesis to a more favourable angulation in order to be restored. [38,39]

Pre-Angled Abutments: these redirect the screw access opening to occlusal or cingulum area by use of two off-axis screws: one screw that secure the abutment into the implant and the second screw that is at an angle to secure crown into bulk of abutment structure. [40] Nobel Biocare provides screw-retained pre-angled abutments with a 17^0 divergence and 30^0 divergence.

Dynamic Abugments: [39] dynamic abutment allows 360^0 variability in abutment angulation upto 280^0 off-axis. The benefit of dynamic abutments is that the labial dimensions are thin.

Angulated Screw Channel (ASC):[41] this offers a simpler alternative to cement-retained prosthesis in the restoration of tilted implants. Major risks include porcelain related failures, screw loosening or fracture , and peri-implant disease. ASC and dynamic abutments are more versatile types of screw-retained restoration.

Abutment Screw

These screws fasten the implant and prosthetic components together. [42]

Abutment screw is the easiest, fastest and most efficient way to fixate prosthetic component to implant body. Abutment screw fixation is also readily retrievable , which is an advantage over cement retained.

Screw retention presents some potential problems, incomplete sealing may contribute to bacterial infection. The coping screw is weakest link in the prosthetic chain. Any occlusal discrepancy in occlusion, casting ,or force may result in vibration and screw loosening or breakage. Factors such as thread design, metal composition, abutment screw connection, anti-rotational features, etc influence the loosening or breakage of screw.

Conclusion

Implant dentistry has matured to a stage where protocols have been set for treatment modalities. Certain challenges still are presented these are governed by patient's biologic and esthetic needs. With the advancement in research, new implant designs and components are being introduced.

A variety of implant components are available to aid the clinician for accomplishing the case satisfactorily. The decision of choice of component is based on various factors of which clinical situation and clinician's preference leads to the selection procedure.

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