Prosthetic components in endosseous and bi-cortical implants: A comprehensive overview.

Maithilie Aggarwal[1], Siddhi Tripathi[2], Neeta Pasricha[3]

[1]Post graduate student, Department of Prosthodontics and Crown & Bridge, I.T.S. Dental college, Muradnagar.

[2]Professor, Department of Prosthodontics and Crown & Bridge, I.T.S. Dental college, Muradnagar.

[3]Professor and Head, Department of Prosthodontics and Crown & Bridge, I.T.S. Dental college, Muradnagar.

Abstract

Background: Understanding the required horizontal and vertical restorative space for various dental implant prosthetic components is crucial in managing both fully and partially edentulous arches. With the growing demand for implants, numerous manufacturers have introduced a wide range of implant brands and components, each varying in design and features.

Objective: This study aims to explore the factors influencing abutment selection and provide insights into the various implant prosthetic components in endosseous and bi-cortical implant systems available the market.

Methods: A thorough review was conducted, focusing on the types of implants, abutment selection criteria, and the evaluation of different abutments available. The importance of considering available restorative space before prosthesis design was also analyzed.

Conclusion: Proper selection of implants and abutments based on clinical criteria is essential for successful prosthesis management. The study underscores the importance of determining the available restorative volume prior to therapy to ensure stable, aesthetically pleasing, and well-contoured prosthetic designs.

Keywords: Abutment material, basal implantology, implant abutments, implant abutment connection, prosthesis retention.

Address of correspondence: Dr. Maithilie Aggarwal, Post Graduate Student, I.T.S. Dental college, Muradnagar
Email address: - maithiliea@gmail.com **Phone no:** 9582895471. **DOI:** 10.5281/zenodo.13356824
Submitted: 18-Jun-2024 **Revised**: 30-Jun-2024 **Accepted:** 15-Jul-2024 **Published:** 16-Aug-2024
Bibliographic details: Journal of Orofacial Rehabilitation Vol. 4(2), Aug 2024, pp. 25-32.

Introduction

Correct design and precise construction of the prosthetic supra-structure and fixed denture that is to be screwed to the abutments are crucial for long-term success of the implant-fixed and supported restoration. The abutments, implant bodies, and necessary bone needs to sustain the particular intended restoration can only be ascertained once the prosthesis has been conceptualized. The cover screw**,** is a component used to occlude the connection of the implant while submerged during a two-stage procedure.[1]

An element that attaches to the dental implant and extends into the soft tissue is called a healing abutment. Either upon implant placement or during the second surgical procedure, it can be attached to the implant to prevent the need for a second operation. Healing abutments are often left in place for a certain period of time, or until the soft tissue has sufficiently healed to allow implant restoration (Fig. 1 and 2).

In areas where aesthetics is not a concern, such as mandibular and maxillary molars, we prefer to use healing abutments with a diameter of 6 or 7.5 mm. A 4 mm or 5 mm healing abutment may be employed in the

edentulous area, which corresponds to teeth with lesser sizes. Custom-made abutments are used in an aesthetically sensitive area. In individuals with a gummy grin or a high lip line, gingival aesthetics become more important. Such abutments are made of titanium, zirconia, PMMA, PEEK, and resin composite materials.[2,3]

Implant- abutment interface geometry

Several implant abutment interfaces have been developed and patented and talk about them since the development of implants itself. The internal hex design and the external hex design. There are several different types of connections: hexagonal, octagonal, spline, tripod, and morse taper.

Implant restorative platform

When the parts are correctly inserted, the internal connection of the implant design incorporates a tactile and auditory "click." lessens the requirement for radiography. Both a 12-point, double-hex internal design and a 6-point hex internal design are used in this internal connection design. The internal hex-straight abutments, with six points. The 12-point, double-hex pre-angled abutments correct the implant's off-axis emergence.

When an implant platform's diameter is greater than the abutment's, this is referred to as platform switching, often called platform shifting. Platform switching has been demonstrated to help achieve soft tissue esthetics by allowing a larger volume of soft tissue at the implant–abutment interface and minimizing bone loss surrounding the implant.[4,5]

In terms of minimizing the crestal bone loss surrounding the implant, this is a viable approach. Today's dental implant and abutment designs incorporate the idea of preserving "horizontal biologic width" by means of integrated platform switching.[6]

Orientation of implant

The implant orientation and angulation are of utmost importance and the final prosthetic rehabilitation depends directly on the orientation of the implants. The parallelism of the implants with the adjacent teeth is a must and thus prior planning needs to be in accordance with the final outcome. Thus, the use of surgical stents while implants placement is a very useful adjunct in the surgical phase of implant rehabilitation.[1,5,7]

The type of prosthesis that is given in the patient also depends upon whether the implants are angulated or not. In general, for parallelly placed implants we can go for a screw retained prosthesis but there is limitation to the screw retained prosthesis when it comes to angulated implants where we need to prefer cement retained prosthesis on an angulated abutment for angle correction (Fig 3).

Interocclusal space:

The prosthesis abutment selection is heavily influenced by the interocclusal space that is accessible. Less interocclusal space is needed for screw-retained restorations that attach directly to implants without the need for an intermediary abutment.[8] On the other hand, adequate retention and aesthetics require at least 8 mm of interocclusal space when an abutment is employed (Fig. 3). To attain the intended retention for cement-retained

restorations, the abutment height must be at least 4 mm. Therefore, screw-retained restorations are frequently a better choice in situations when there is little interocclusal space.[5.9,10]

Retrievability

Screw-retained restorations offer the advantage of easy retrieval without causing damage to the prosthesis or implant, which simplifies future follow-ups and evaluations. In contrast, retrieving cement-retained restorations is more challenging and can be unpredictable, potentially resulting in damage to the implant and restoration. To mitigate this issue, various modifications have been suggested. One effective approach involves removing the abutment and prosthesis together by accessing the abutment screw through an occlusal access hole. This method entails creating an access hole on the lingual side of the restoration and a round guidance hole on the abutment's lingual surface. A driver is then inserted through the access hole into the guide hole, and by turning it to apply shear force, the cement is loosened, allowing for the easy retrieval of the restoration.[5,10]

SINGLE PIECE V/S TWO PIECE ABUTMENTS

A single-piece abutment lacks a supplementarty retaining screw and instead connects to the implant via friction or threaded engagement. Conversely, a two-piece abutment comprises 2 components: one that engages the anti-rotational feature and another that secures the abutment to the implant. Single-piece implants are commonly employed in immediate and provisional restorations. These abutments are characterized by their structural robustness, reduced component requirements, precise control over the final restoration fit, and cost-effectiveness. Nevertheless, the positioning procedure for single-piece abutments is more intricate and may compromise implant stability and osseointegration.

Recent advances in implant abutments

I. Angulated abutments

- Used to enhance the prosthesis insertion process or the aesthetic outcome in the end.
- Weaker design- fabricated in 2 pieces.
- Inclination ranges from 10-35^0
- Non-rotating interface with implant.

II. UCLA abutments

- Designed by John Beumer, Wynn Horn burg, and Peter E. Staubli
- Placement of the repair beneath the gingiva.
- Aids in overcoming interocclusal distance restrictions.
- The occlusally extending UCLA castable abutment features a shoulder in the apical region. The shoulder design allows for sufficient bulk of porcelain at the finish line without overbuilding the restoration.[6]

III. Ceramic abutments

a. Alumina abutments:

- 400 MPa flexural strength
- A fracture toughness rating of 5 to6 MPa
- 350 GPa is the elasticity modulus.

Advantages:

- Simpler to intraorally prepare
- Whiter than zirconia abutments

Disadvantages:

- Radio-opalescence during the radiographic assessment.
- Feeble ability to withstand breakage.

b. Zirconia abutment:

i. 900–1400 Mpa, which is twice the flexural strength of alumina ceramic.
ii. Up to 10 Mpa⁄M of fracture toughness,
iii. Value of the modulus of elasticity: 210 Gpa

Advantages:

- Perfect aesthetics and stability.
- Maximum fit accuracy.

Indications:

- Anterior esthetic zone of the maxilla.
- Elevated smile line.
- Thin biotype of soft tissue.

MULTI-UNIT ABUTMENTS

The different angulations and depths of implants in full-arch instances can affect prosthesis design and complicate the restorative phase of treatment. By adjusting implant angulations, making it easier to place the restoration bringing the implant connection up near the surface of the gingiva, and establishing a flat prosthetic platform, multi-unit abutments solve these issues. When taking into account the total amount of time and resources required, multi-unit abutments are an investment well worth making in order to achieve predictable, precise, and efficient restorations. For fixed screw-retained restorations of totally and partially edentulous arches, such as the all-on-4 concept, multi-unit abutments are designed. They are available in straight and angled versions (17° and 30°) with collar heights that vary to accommodate different thicknesses of soft tissue. They are compatible with nearly all implant platforms and serve as connections between different implant screw-retained restorations and dental implants. All screw-retained full-arch prostheses should have multi-unit abutments, which address height and implant angulation inconsistencies to create a level restorative platform. They have a number of advantages, such as passive drawing, simple and predictable seating of the restoration, less stress on the restorative system because of the passive seating procedure, and simple removal and replacement of the prosthesis during patient follow-ups.[5,10]

BASAL IMPLANTOLOGY

Over the years, dentists in Germany and France have developed and modified basal implants, usually in stages. Dr. Jean-Marc Julliet created and employed the first single-piece implant in 1972, and it is still in use today. The biggest disadvantage is that there isn't a surgical kit included. Multiple unit restorations in the upper and lower jaws are made with BASAL implants. Both healed bone and extraction sockets can benefit from their use. The anatomical characteristics enable the integration of bones with excessively small height and width.[9]

Dr. Stefan Ihde began producing lateral basal implants resembling Diskimplants in 1997. These implants came in a variety of sizes and forms and were first given a rough surface. The basal implant was soon improved by Dr. Stefan Ihde; He gave spherical base plates edges, screwable designs (BCS, GBC) were developed in 2005, and he added bending zones to the vertical implant shaft to stop the implants from spinning in the bone before they integrated. In 2002, a fracture-proof base plate was developed, and it was later granted patents in the US and Europe.

Implant Morphology

Modern BOI and BCS implants have a smooth, polished surface because studies show that smooth surfaces are less prone than rough surfaces to induce inflammatory conditions such mucositis and peri-implantitis. On the other hand, the KOS and KOS Plus implants have their surfaces treated with sand and grit blasting and acid etching, but the KOS implant's neck is left extremely polished. The basal cortical screw portion and the neck of the KOS Plus implant are both highly polished. (Table 1).

A. BOI Implant Morphology

To increase its strength, the BOI implant can be constructed from pure titanium or a titanium-molybdenum alloy. These implants, which come in single or two pieces, are made up of the following components:

Abutment: The conical abutment section of single-piece BOI implants is visible inside the mouth. The externally or internally threaded screw abutment of a two-piece BOI implant might have an octagonal or hexagonal restorative platform on the outside. Neck: The neck, which is situated immediately below the abutment part, could have a narrow diameter. This constriction decreases rigidity, permits bending by 15°–25°, and aids in gingival adaptability following healing. Shaft: The implant's vertical shaft serves as a connector between each part. To stop irritation and plaque buildup, it is kept polished and smooth. The shaft might be rigid or elastic, depending on the type of titanium utilized and its diameter. Its normal length is between 10 and 13.5 mm, and its main function is load carrying.

B. BCS Implant Morphology

Similar in design to the BOI implant, the BCS implants are one-piece implants that have particular changes made to the implant and abutment sections. Conical Angled, Multi-Unit, and Conical Straight abutments are the available abutment options for BCS implants. The BCS implant features cutting screws with a broad diameter., in contrast to the BOI implant, which has disks inside its implant part. By helping to engage the buccal and palatal/lingual cortical plates, these screws help the implant achieve its initial primary stability and load-bearing capacity. They thus serve as essential load-bearing and distribution elements. BCS implants are made as implants that are flapless and have a very little diameter of mucosal penetration, and they are also distinguished by a thorough polishing procedure.

B. KOS/KOS PLUS implant Morphology

These implants are made of a single component. They are composed of an alloy known as titanium molybdenum or titanium aluminum vanadium. In that the surrounding cancellous bone is crushed during insertion to produce denser, more compact bone, their architecture is comparable to that of compression screws.

Abutment portion:

This serves as the platform for restoration of the implants and is still visible inside the mouth. They offer a diverse range of abutment options, including:

- Conical Straight abutments with vertical microgrooves for anti-rotational stability are available for cemented crowns.
- Angled conical abutments.
- Locator abutments.
- Ball abutments.
- Multi-Unit abutments. (these abutments are part of single-piece implants)

ii. Neck: The implant's neck is narrowed and highly polished to promote better gingival adaptation and prevent plaque buildup. It has a 15°–25° bending range for maximum flexibility.

iii. Implant Portion: Cancellous bone can be compressed by them and changed into denser cortical-like bone. because of the large structure and vast twists of the threads in this location. The apical part of the KOS Plus implant has basal cortical screws, which support early stability by activating the palatal/lingual and buccal cortical plates.. These screws will later be used as parts that support and distribute loads. Interestingly, the BCS part of the KOS Plus implant is always incredibly well-polished.[9]

Conclusion

In conclusion, while conventional implantology offers established prosthetic components that integrate well with traditional treatment protocols, basal implantology presents a valuable alternative with its robust and often less invasive approach. Both methodologies aim to restore function and aesthetics effectively, each catering to different clinical scenarios and patient needs. Whether opting for the familiarity of conventional methods or the innovation of basal techniques, the ultimate goal remains steadfast: to provide patients with durable, functional, and aesthetically pleasing prosthetic solutions tailored to their individual oral health requirements.

References

1. Resnik R. Misch's Contemporary Implant Dentistry. 4th ed. St. Louis, MO: Mosby; 2020.
2. Rathee, et al.: Dental implant abutment selection. J Adv Oral Res 2014; 5(3)
3. Drago C. Implant restorations: A step-by-step guide. 3rd ed. Nashville, TN: John Wiley & Sons; 2014.
4. Carpentieri J, Greenstein G, Cavallaro J. Hierarchy of restorative space required for different types of dental implant prostheses. J Am Dent Assoc. 2019;150(8):695–706.
5. Hamed MT, Abdullah Mously H, Khalid Alamoudi S, Hossam Hashem AB, Hussein Naguib G. A systematic review of screw versus Cement-Retained Fixed Implant Supported Reconstructions. Clin Cosmet Investig Dent. 2020;12:9–16.
6. Shah RM, Aras MA, Chitre V. Implant abutment Selection: A Literature Review. Int J Oral Implantol Clin Res 2014;5(2):43-49.
7. Rasaie, V., Abduo, J., & Falahchai, M. (2022). Clinical and Laboratory Outcomes of Angled Screw Channel Implant Prostheses: A Systematic Review. *European journal of dentistry*, *16*(3), 488–499.
8. Chee W, Jivraj S. Impression techniques for implant dentistry. Br Dent J. 2006;201(7):429–32.
9. Aakarshan Dayal Gupta, Aviral Verma, Tanay Dubey, Saloni Thakur. Basal osseointegrated implants: classification and review. International Journal of Contemporary Medical Research 2017;4(11):2329-2335.
10. Benakatti V, Sajjanar JA, Acharya AR. Dental implant abutments and their selection - a review. J Evolution Med Dent Sci 2021;10(35):3053-3059.

TABLES

Category	Design Type
I) Screw Form	
1. Compression Screw Design	KOS Implant
2. Bi-Cortical Screw Design	BCS Implant
3. Compression Screw + Bi-Cortical	KOS Plus Implant
4. Basal Osseointegrated Implant	BOI/Trans-Osseous embed (TOI)/Lateral Implant (Disc Form)
II) Plate Form	
1. BOI-BAC Implant	
2. BOI-BAC2 Implant	
III) Disc Form	
1. Single Disc	
2. Two-fold Disc	
3. Triple Disc	
IV) Forms	
1. TPG Implant	Tuberopterygoid
2. ZSI Implant	Zygoma Screw
1) According to the abutment connection	
1. External Threaded Connection	
2. Threaded Internal Connection	
3. Hexagon on the Outside	
4. Octagon on the Outside	
2) Considering the basal plate design	
1. Basal Circles with angled Edges	
2. Basal Circles with Equal Edges	S-Type Implants

Table No. 1

FIGURES

Figure 1.

Figure 2.

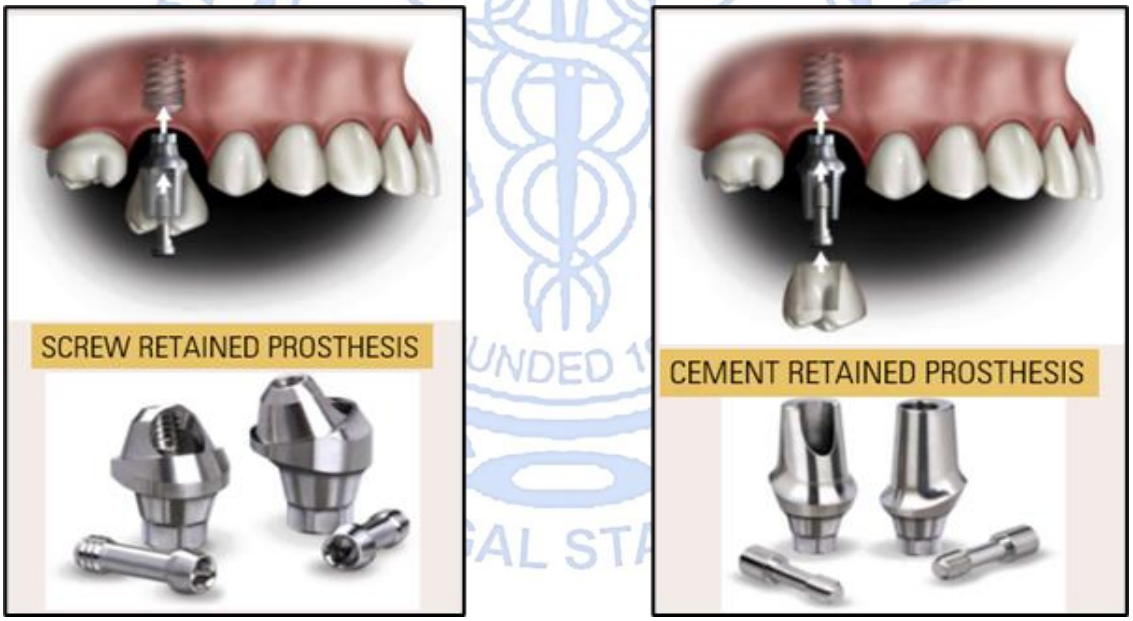

Figure 3.