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An Overview of Prosthetic Implant Attachments in Edentulous Patients

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Abstract: *Edentulism is an unresolved health care issue of sustained significance and prevalence in the aged population. Adaptation to wearing complete dentures is a complex process and must be considered from both somatic and psychological standpoints. The difficulties of wearing dentures have been attributed to deficiencies of the denture-bearing tissues, reduced salivary flow, vulnerable tissue and severe ridge resorption. The prosthetic management of the edentulous patient has always been a major challenge. Complete maxillary and mandibular dentures have been the traditional treatment option. However, most of the patients report problems adapting to the mandibular denture due to lack of comfort, retention and stability. It is well known that implant-retained/supported overdentures provide improved retention, support, stability, function, and comfort for patients.*

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I. INTRODUCTION

Adaptation to wearing complete dentures is a complex process and must be considered from both somatic and psychological standpoints. Although implants have offered a great service to partially edentulous patients, the most dramatic changes in treatment have been achieved in completely edentulous patients with atrophic mandibles and/or maxillae. In cases in which the retention of the dentures is extremely difficult or impossible,

In completely edentulous patients, implants can be used in conjunction with attachments to enhance the retention and stability of overdentures.

Various types of attachment systems are available, and different manufacturers provide different variety of attachment designs, but mainly there are four types of attachment assemblies which are commonly used:

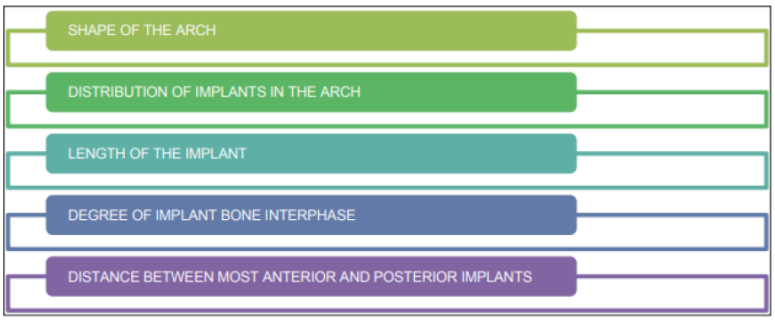
- Stud attachments
- Bar attachments
- Magnetic attachments
- Telescopic attachments

USES OF ATTACHMENTS

- The use of attachments can redirect occlusal forces away from weak supporting abutments and on to soft tissue, or redirect occlusal forces toward stronger abutments and away from soft tissues.
- They act as shock absorbers and stress redirectors as well as providing superior retention.

FACTORS INFLUENCING THE DESIGN AND RESILIENCY LEVEL OF THE ATTACHMENT ASSEMBLY

The design and resiliency level of the attachment assembly are influenced by the following aspects.



Almost all the attachment systems available show different levels of resiliency. It is associated with the movement between the abutment and prosthesis in predetermined directions. The more resilient the attachment, the more will be movement and more stress distribution on the residual ridges, and less stress concentration on the implant. Various movements allowed by resilient attachments are:

STUD ATTACHMENTS:

Stud shaped attachments have served as overdenture abutments for several decades. Most are straightforward to use and possess favorable retention characteristics. Stud devices are among the simplest of all attachments. They can provide additional stability, retention, and support, while the positive lock of certain units can maintain the border seal of the denture.

Stud attachments consist of a female part that is held in place by friction over the male stud and incorporated into the denture resin. This integration process can occur either directly in the mouth using light-polymerized or self-cured resin, or through the use of a transfer coping system, creating a master cast that replicates the attachment. These attachments are categorized based on their function into resilient and non-resilient types.

a) BALL AND RING ATTACHMENTS:

Ball attachments are among the simplest of all stud attachments widely used because of their low cost, ease of handling, minimal chair side time requirements, and their possible applications with both root and implant-supported prostheses.

For unsplinted implants, the most common attachment used is the ball attachment.

This attachment system is a practical, effective, and relatively low-cost prosthetic option. Ball attachments were claimed to be less costly, less technique-sensitive and easier to clean than bar attachments. Moreover, the potential for mucosal hyperplasia was reduced with a ball attachment. The ball and socket attachments consist of a metal ball (male portion) which is inserted into the implant, whereas the female part is incorporated in the fitting surface of the denture.

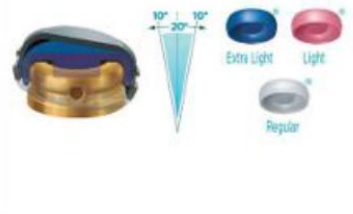
b) LOCATOR ATTACHMENT:

It was conceived by R and D specialist Scott Mullaly of Zest Anchors, LLC in the year 2000.

The Locator was designed for ease of insertion and removal, dual retention, a low vertical profile, and a unique ability to pivot, thus increasing its resiliency and tolerance for implant divergence. The Locator Attachment is designed to reduce the height of attachment and abutment. With a total attachment height of only 3.17mm (male plus 1mm collar abutment). The Locator attachment saves a minimum of 1.68mm to 3.05mm of interocclusal space compared to other implant overdenture attachments.

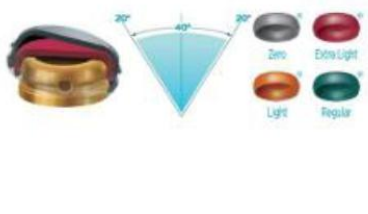
Pivoting Action of the Locator

STANDARD INSERTS



Dual retention to maximize stability and pivoting action that accommodates up to 20° of total divergence between two implants.

EXTENDED RANGE INSERTS



Pivoting action accommodates up to 40° of total divergence between two implants.

Extended range male attachment allows to restore a non-parallel implants with up to 20 degrees of angulation. This calculates to an extensive 40 degrees of divergence between two implants. It is classified as a resilient universal hinge device, and is designed for limited inter-arch distances, enabling inter-implant angles to be fixed up to 40º. Dual retention, pivoting action provides resiliency to maximize stability and longevity.

BAR ATTACHMENTS

The bar and clip attachments are probably the most widely used attachments for implant tissue-supported overdentures as they offer greater mechanical stability and more wear resistance than solitary attachments. In addition, short distal extensions from rigid bars can be achieved which contribute to the stabilization and prevent shifting of the denture.

The bar attachment consists of a metallic bar that splints two or more implants or natural teeth spanning the edentulous ridge between them and a sleeve (supra structure) incorporated in the overdenture which clips over the original bar to retain the denture. The bar attachments are available in a wide variety of forms; they could be prefabricated or custom-made.

There are two basic types based on the shape and the action performed:

- Bar joints (resilient) provide vertical and/or hinge resiliency.
- Bar units (non-resilient)

Bar joints that permit some degree of rotation or resilient movement between the two components. Spacers should be provided to ensure a small gap between the sleeve and the bar during processing. Bar joints are subdivided into two types: Single sleeve and multiple sleeves; the single sleeve has to run straight without allowing the anteroposterior curvature of the arch, so it is used in square arches. On the other hand, the multiple sleeves can follow the curvature of the arch. It also enables the use of more than one clip. Bar units that provide rigid fixation of the overdenture allowing no movement between the sleeve and the bar. The assumed advantage of bar attachment is the better transmission of forces between the implants due to the primary splinting effect, load sharing, betterretention, and the least post-insertion maintenance.

MAGNETIC ATTACHMENT

Magnets have been used in various fields of dentistry for about 60 years. As magnets are readily available and simple to use, they have often been used and evaluated to stabilize and retain removable dental prostheses. Magnetic retention is a popular method of attaching the removable prosthesis to osseointegrated implants. The magnet is usually cylindrical or dome-shaped and attached to the fitting surface of the acrylic resin base of the overdenture. The magnetic keeper casted to a metal coping cemented to root surface or screwed over the implant fixture. The magnet system used for overdenture retention incorporates the magnet into the overdenture which is a neodymium-iron-boron alloy or a cobalt-samarium alloy. The second part of the magnetic systemis the ferromagnetic keeper which is screwed into the implants.

The advantages of magnetic attachments are • Magnetic attachments are shorter compared to mechanical attachments so can be used in cases of reduced inter-arch space. • They can be used in moderately nonparallel abutments since they do not follow a particular path of insertion. • Laboratory procedures associated with castings are not necessary • They are more resilient and allow for free movement of the prosthesis.

Disadvantages are • Attachment needs to be removed before taking magnetic resonance imaging because it causes streaking. • When the number of implants are relatively few, retention is not as good as when ball attachments are used • Least retention.33 • Heating during sterilization leads to a decrease in retentive forces in long-term use.

TELESCOPIC ATTACHMENTS

Telescopic crowns were initially introduced as retainers for removable partial dentures (RPDs) at the beginning of the 20th century. • Telescopic crowns are also known as double crown, crown, and sleeve coping. • These crowns consist of an inner or primary telescopic coping, permanently cemented to an abutment, and a congruent detachable outer or secondary telescopic crown, rigidly connected to a detachable prosthesis.35 • The use of telescopic retainers has been expanded to include implant-retained prostheses to make use of their enormous advantages. • These retainers provide excellent retention resulting from the frictional fit between the crown and the sleeve.

Recent Advances and Future Perspectives

• Research and clinical applications in implant dentistry have led to the development of various bio and digital prosthetic dentistry materials. • A key developmental component has comprised advances in artificial intelligence (AI), which has been implemented in several dental and dental technology workflows, especially that of CAD/CAM [53]. • Newer materials can be integrated with overdenture attachment systems. Recently, polyether ether ketone (PEEK) and polyether ketone ketone (PEKK) have been widely used in implant and restorative dentistry [56,57] • Li et al. [6] evaluated the retention of PEEK post-core restoration with polyvinylsiloxane (PVS) attachment systems (Figure 5), and their cyclic dislodgement test showed an inverse linear relationship between cyclic times and retention force. • The PVS's retention was enhanced with an increase in Shore hardness, thus showing a favorable retention force. • Therefore, post-core PEEK with PVS attachments may comprise an excellent alternative attachment system in dentistry.

II. CONCLUSION

To provide a successful treatment, the clinician should have a thorough knowledge of various attachments available, their use in various clinical situations, and their advantages and disadvantages. Selection of attachment should be based on proper diagnosis of intraoral structures and various factors such as bone type and inter-arch space which are important for successful results. While using any particular type of attachment system the clinician should try to fulfill all the requirements which are essential for stable results for successful esthetic and functional rehabilitation. Informing patients in advance about the need for maintenance is essential for treatment success and for avoiding unexpected events.

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