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Types and Materials of Precision Attachments

A Project Submitted to

The college of dentistry, University of Baghdad, Department of Prosthodontics in Partial Fulfillment for the Bachelor of Dental Surgery

By

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وَلَمَّا بَلَغَ أَشُدَّهُ وَاسْتَوَى آتَيْنَاهُ حُكْمًا وَعِلْمًا
وَكَذَٰلِكَ نَجْزِي الْمُحْسِنِينَ ۝

صَدَقَ اللَّهُ الْعَظِيمُ

القصص ١٤

Certification of the Supervisor

I certify that this project entitled "**Types and Materials of Precision Attachments**" was prepared by the fifth-year student **Ali Qahtan Sameer** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Assistant Professor Dr. **Firas Abdulameer Farhan**

Date

Dedication

I humbly dedicate this piece of work to the ones who have always been there for me and gave me Love and Inspiration along my studying currier.

To my loving parents for their endless guidance and support. And to my very special sisters.

To my all supportive friends, specially **Hussein, Shams, Ali, Hamosh, Hadosh and Wissam,** who have been my source of inspiration and gave me strength when I thought of giving up, I will always appreciate all what they have done for me.

I also dedicate this work to my study partner **Ali Sinan Abbas** who has supported me throughout the process.

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List of abbreviations

RPD	removable partial denture
FPD	fixed partial denture
CAD/CAM	computer-aided design/computer-aided manufacturing
ERA	Extracoronal resilient attachments
PEEK	polyether ether ketone
PVS	polyvinylsiloxane

INTRODUCTION

Precision attachment is a technique that has become increasingly popular in the field of prosthodontics, as it provides a reliable and secure connection between dentures and the remaining teeth. This technique has revolutionized the way dentists approach partial denture design, allowing for a more natural-looking and comfortable fit for patients. Precision attachments offer considerable advantages because of their flexibility. Nevertheless they have been ignored in the past largely due to notable cost and an inadequate grasp of their application. The last decade has seen the public become better (**Prasad et al., 2016)**.

Various types of attachments have been developed. The precision attachments are very precise, and are milled out of alloy. The male and female parts fit together with tolerances of about 10 microns. They are purchased as a finished product and are soldered or cast to the final prosthesis. They are incorporated within the contours of the crown or splint and direct the forces of occlusion down the long axis of the tooth. They are generally rigid attachments in that the prosthesis is able to transfer most of the occlusal force to the teeth in which the attachments are incorporated, and less to the tissue-bearing areas **(Bambara et al., 2012).**

One of the key advantages of precision attachment is that it provides a more stable connection than other types of attachments. This is because precision attachments are designed to fit precisely onto the remaining teeth, ensuring that the denture stays in place even during activities such as eating, speaking or laughing. Attachment-retained dentures have garnered high patient satisfaction because of their retention characteristics. However, they require routine maintenance and periodic repairs because they are susceptible to wear and damage, and hence loss of retention **(Gozneli et al., 2013)**.

The purpose of using precision and semi-precision attachments is that they function as the retentive and supporting elements while redirecting the occlusal forces onto the areas that can support or share the masticatory loads. Keeping natural teeth or roots allows for proprioception and maintains alveolar bone levels **(Bambara et al., 2012).**

Precision attachments open a horizon of possibilities in prosthodontic rehabilitation. Varieties in size, shape and configuration allows them to be utilized in many clinical scenarios. However, the complex prosthesis with attachments does not serve the purpose of retention and esthetics but makes it heavy for the patient **(Prasad et al., 2016).**

Technological advancements like the internet have provided patients with the power of knowledge of the oral environment together with the fact that their restorations be esthetically pleasing, functional and comfortable. The desire to balance between functional stability and cosmetic appeal in partial dentures gave rise to the development of precision attachments. From their first introduction to the dental profession, precision attachments have been surrounded by an aura of mystery, implying that greater skill is required in their use. This has served as a contributing factor discouraging their general use. From a patient's view point, no other appliance offers more comfort, security and esthetics than the precision attachment offers **(Rani et al., 2016).**

Aims of the Study

1. To review the different types of precision attachments available and their suitability for various clinical situations.
2. To explore the advantages and disadvantages of different materials used in precision attachments, such as platinum, gold, or zirconia.

Chapter One
Review of Literature

Chapter one
Review of Literature

1.1. Causes of Partial Edentulism

Partial edentulousness is the state of missing one or more but not all natural teeth in the oral cavity, which could arise from multiple reasons including most commonly caries and periodontal diseases **(Prabhu et al., 2009; Abdel-Rahman et al., 2013).**

Moreover, the other causes of partial edentulism are trauma, failed root canal treatments, supernumerary, congenital absence, tumor, cyst, and neoplastic lesions (**Zaigham et al., 2010; Ehikhamenor et al., 2010; Muneeb et al., 2013).**

Partial edentulism adversely affects the neighboring teeth gradually causing drifting and supra-eruption of opposing arch teeth into the edentulous space. Patient encounters difficulty in speech, inadequate mastication, altered facial features, and temporomandibular joint dysfunction leading to dietary alteration lacking nutrients resulting in poor physical and mental health (**Zaigham et al., 2010; Jeyapalan et al., 2015).**

1.2. Partial Denture Component

Each component of a RPD has a name that is descriptive of its function. For example, a major connector serves as the principal method for connecting the opposing sides of a removable partial denture. A minor connector joins smaller components to the major connector. A rest contacts the surface of the abutment tooth to prevent movement of the RPD toward the underlying tissues. A clasp assembly grasps an abutment tooth and resists removal of the prosthesis. Components of a clasp assembly are further classified as retentive and reciprocal elements based upon their primary functions.

Retentive clasps are designed tokeep a RPD in position, while reciprocal clasps are intended to brace abutment teeth upon insertion and removal of the prosthesis. Every RPD will have some or all of the following components: Major connector, Minor connectors, Rests, Direct retainers/clasps, Indirect retainers, One or more denture bases in conjunction with prosthetic teeth **(Phoenix et al., 2003).**

1.3. Retention in partial denture

Retention is that quality inherent in the dental prosthesis acting to resist the forces of dislodgment along the path of placement. **(GPT-9, 2017)**.

In other term is the resistance of the partial denture to vertical displacement away from the tissues. Sufficient retention is provided mechanically by placing retaining elements such as (direct retainers) on the abutment teeth **(Davenport et al., 2000).**

1.4. Retentive component of partial denture

Retentive component any unit of RPD that engages an abutment tooth in such a manner as to resist displacement of the prosthesis away from basal seat tissues by Functional means: by engaging a tooth undercut present cervically to the height of the contour and Mechanical means: to support,provide retention and bracing the tooth **(Henderson et al., 2011).**

A unique concern of a removable denture when compared to others is retention. As mention previously the component of removable denture which provides retention is called as direct retainer. Direct retainers is defined as any type of clasp, attachment or a device used for the fixation, stabilization or retention of a prosthesis. Direct retainer can be either an extracoronal or intracoronal retainer. Extracoronal direct retainer uses mechanical resistance to displacement through components placed on external surface of abutment teeth.

Intracoronal retainer is either cast or attached to tally within the restored natural contours of an abutment tooth **(Angadi et al., 2012).**

One of the main drawbacks of extracoronal retainers used in partial dentures is visibility. Many patients find themselves in an aesthetically compromised state when these retainers are placed on teeth in visible area. Precision attachments provide solution for this problem. In addition, precision attachments provide better vertical support and better stimulation to the underlying tissue through intermittent vertical massage **(Mishra et al., 2021).**

Precision and semi-precision attachment in dentistry allows for esthetic that do not display the metal clasps that can make traditional removable clasped cast partial dentures unaesthetic. The attachment itself becomes the clasp, rest, reciprocating and stabilizing element and is hidden inside the partial denture, which renders it invisible. The attachment also provides the retentive element necessary to retain the partial denture in the mouth at rest and during masticatory function. In Figure 1.1A & 1.1B the difference between traditional clasps and precision attachments **(Bambara et al., 2012).**

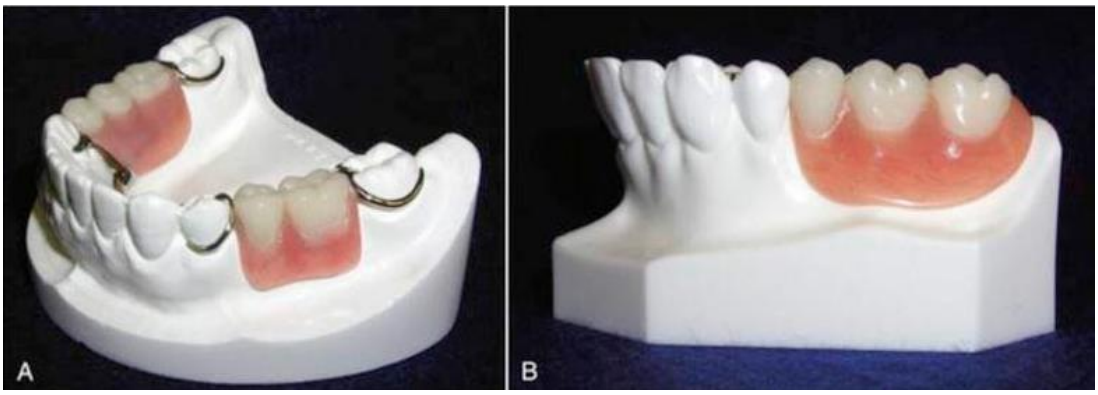

Figure 1.1: A, clasped cast partial denture. B, Precision attachment partial denture. (Bambara et al, 2012)

The attachment is defined as "**A mechanical device for the fixation, retention, and stabilization of prosthesis**". Or can be described as a retainer used in FPD with RPD construction consisting of a metal receptacle and a closely fitting part, the former is usually contained within the normal or expanded contours of the crown of the abutment tooth, and the latter is attached to a pontic or to the denture framework **(Angadi et al., 2012).**

Precision attachments are two precocious metal components those are manufactured to form an articulate joint. First component or matrix is a metal receptacle or keyway, which is positioned within the normal clinical contours of a cast restoration placed on the attachment and the second component or patrix, is attached to the RPD Figure (1.2). The precision attachment is sometimes defined as a connecting link between FPD and RPD as it incorporates features common to both types of construction (**Arti et al., 2018).**

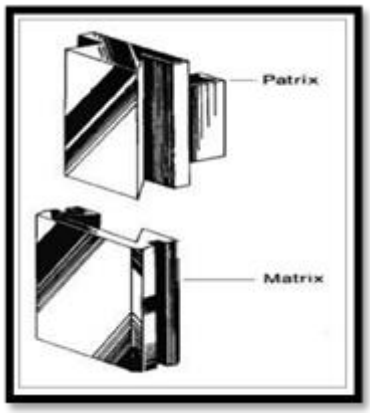

Figure 1.2 components of precision attachment. (Arti et al., 2018)

Dental precision attachments connect RPD to fixed bridgework under a male/female locking mechanism. A synonym for precision attachment: Internal attachments, Frictional attachments, Slotted attachments, Parallel attachments, and Key and keyway attachments **(Angadi et al., 2012).**

1.5. Definitions for precision attachments

Precision attachments a retainer consisting of a metal receptacle (matrix) and a closely fitting part (patrix); the matrix is usually contained within the normal or expanded contours of the crown on the abutment tooth/dental implant and the patrix is attached to a pontic or a removable partial denture **(GPT-9, 2017).**

A precision attachment is whole or partly machined accessories used in dentistry for the retention of removable or semi removable prostheses. In most cases, they take the form of articulated joints **(Williams et al., 2014).**

Precision attachments offer potential advantages in restorative dentistry, particularly in removable prosthodontics. In general, the uses of precision attachments in dentistry are for bridgework: intracoronal and extracoronal attachments can be used to overcome the problem of non-parallel abutments; partial dentures, including free-end saddle dentures (unilateral and bilateral); overdentures and implants **(Jenkins, 1999).**

1.6. Clinical development and evolution of the precision attachment

The history of precision attachment work dates back to 1886, when Stair devised a unilateral removable partial denture employing anterior and posterior telescopic abutment restoration. Parr (1886) gave "Extracoronal socket attachment". George Evans in 1888, got the credit for the introduction of the precision attachment retainer system **(Kanathila et al., 2018).**

The use of attachments as connectors was popularized in the twentieth century by Dr Herman E.S. Chayes. In 1906, developed the T shaped precision attachment. In 1912, he designed Chayes attachment Figure **(1.3).** This forms the basic pattern for most of the modern attachments. He fabricated dental

bridgework in segments that were connected by a key and keyway attachment. The attachments allow for micro-movement between segments and provide stress relief to the connected abutment teeth. His philosophy was to provide a physiologic tooth movement similar to that of natural teeth by using dental attachments in treatment planning prosthetics. This concept eventually led to the development of various rigid or resilient stress-relieving or stress-breaking attachments **(Bambara et al., 2012; Reeta et al., 2017).**

Ash in 1912 introduced the split bar attachment system. Helmut Hader in 1960 discovered the Hader bar, those available as prefabricated plastic pattern. In 1923, the first semi precision attachment was given by Gillet **(Kanathila et al., 2018).**

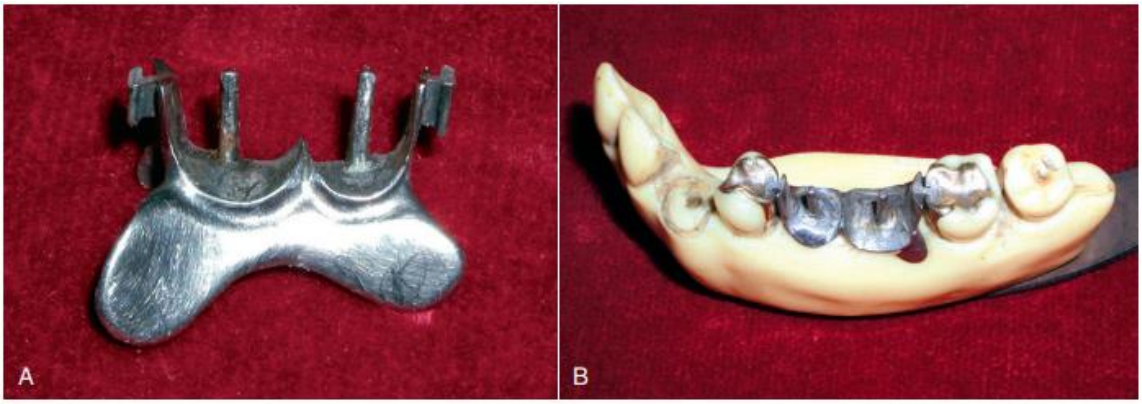

Figure 1.3: A, Chayes attachment. B, Chayes attachment in place. (Bambara et al., 2012)

Integration of computer-aided design (CAD) and computer-aided manufacturing (CAM), have brought revolution in the field of maxillofacial prosthetics during the last decade. with benefits including precise planning, predictable outcome, considerably less clinical and laboratory time, Using CAD/CAM technology to fabricate inlays, onlays, fixed and even removable prostheses is becoming increasing popular **Figure (1.4).** The presence of the available software and the scanners enables the clinician to either scan the wax/

plastic pattern and mill the attachment in the desired material with improved accuracy and thus avoiding the laboratory steps of casting CAD/CAM has proved to have a higher precision and accuracy. The reason for the improved accuracy is several folds. The accuracy is partially owed to the fact that it uses less fabrication steps. It has been established that each fabrication step has its own margin of inaccuracy **(Abdelrehim et al., 2020; Tanveer, 2021).**

CAD/CAM fabrication skips impression, cast pouring, investing and alloy casting. The accuracy might be also due to the accuracy of the scanner and the milling machine used when compared the conventional laboratory steps. **(Abdelrehim et al., 2020).**

Figure 1.4: CAD/CAM fabricated bar attachment (Abdelrehim et al, 2020)

1.7. Criteria for attachment selection

There are a few criteria that help to decide the appropriate attachment based on the individual need of the case, location, function, retention, space, and cost **(Mahida et al., 2017).**

Therefore the Available bone , Patient's prosthetic expectations, Financial ability of the patient to cover treatment costs, Personal choice and clinical expertise of the dentist Experience and technical knowledge of the lab technicians Patients with advanced resorption of the alveolar ridge are good candidates for bar or telescopic attachment assemblies. These attachments offer a considerable amount of horizontal stability. Patients with minimum alveolar ridge resorption are good candidates for studs or magnetic attachments assemblies. Magnets provide the least amount of retention compared to the other attachments, and they lose their initial retention capacity very soon. Studs are ideal for patients with a narrow ridge, because in these cases the bar would interfere with the tongue space **(Sadan et al., 2005).**

The relevance of attachments in prosthodontics can be assessed from its wide array of uses, its application in the field in partial denture restoration, over denture restoration, crown and bridge restoration, implant restoration. Figure (1.5) **(Prasad et al., 2016).**

Figure 1.5: Relevance of attachment in prosthodontic dentistry (Prasad et al, 2016)

1.8. Mechanism of action of precision attachment:

Retainers must hold the prosthesis securely in place during chewing, swallowing, speaking, and other oral functions, therefore, male and female portions must fit preciously **(Angadi et al., 2012).**

Mode of action of attachment was achieved by following mechanisms:

(**Rani et al., 2016; Arti et al., 2018).**

1. **Friction**

Occurs when parallel walls of closely fitting bodies pass over one another. The frictional force is directly related to the area of the opposing surfaces as well as to the length of axial walls.

2. **Binding**

Occurs when a parallel walled body tips within its receptor site.

3. **Wedging of conical bodies**

Friction comes into play only in the terminal position and is lost as soon as the bodies begin to separate.

4. **Internal spring loading**

The friction within retainers is often increased by loading with internal spring clips. Slots in the male portion allow the pressure to beadjusted.

5. **Active Retention**

That is when one body must be temporarily deformed to be withdrawn from its fully seated position. Active retention means a physical obstruction to separation of other parts. One part must undergo elastic deformation before separation can occur.

1.9. Classification of precision attachment

1.9.1. Based on their method of fabrication and the tolerance of fit between the components:

Precision attachment (prefabricated types) :prefabricated machined components with precisely manufactured metal to metal parts with close tolerance. They are generally intracoronal and non-resilient. Precision attachment can be described as a retainer used in fixed and removable partial denture construction consisting of a metal receptacle and a closely fitting part, the former is usually contained within the normal or expanded contours of the crown of the abutment tooth, and the latter is attached to a pontic or to the denture framework **(Prasad et al., 2016; Kanathila et al., 2018).**

Precision attachment are prefabricated, they are made of precious metal, and fit of two working elements is machined to very close tolerances and hence is more precise than laboratory fabricated attachment **(Mishra et al., 2021).**

Semi precision attachment (laboratory-made or custom-made types): components usually originate as prefabricated or manufactured patterns (made of plastic, nylon, or wax) or hand waxed **(Arti et al., 2018).**

A Semi-Precision attachment is fabricated by the direct casting of plastic, wax, or refractory patterns. They are considered “semi-precision” since in their fabrication they are subject to inconsistent water/powder ratios, burn out temperatures and other variables. The resulting components therefore, vary to a small degree. They are less costly, easy to fabricate and may be cast in alloy. Figure (1.6), they are generally extra coronal and resilient **(Gozneli et al., 2013).**

Figure 1.6: semi precision attachment (Jain et al,2017)

1.9.2. Based on their relationship to the abutment teeth:

Intracoronal/internal attachment: If the attachment resides within the body/normal contours of the abutment teeth. They come as two components, matrix and patrix. Matrix (female component) is waxed into the crown or bonded into a preparation in the tooth. Patrix (male component) is attached to the framework usually by soldering **Figure (1.7)**. The advantage is that the occlusal forces exerted upon the abutment tooth are applied close to the long axis of the tooth (**Gareth Williams, 2014; Rani et al., 2016).**

An intracoronal attachment usually requires a box preparation to allow the attachment to fit within the crown contour. If it is not possible to create a box preparation that will totally incorporate the female element, then an extra coronal attachment should be considered **(Prasad et al., 2016)**.

Figure 1.7: Intracoronal attachments. Inlays incorporating intracoronal attachments (C. W. Barclay, 2001)

Extracoronal / external attachment: the attachment resides outside the normal clinical contours of the abutment crown / teeth. They are positioned entirely outside the crown **Figure (1.8).** The advantage of this type of attachment is that tooth reduction is less than an intra-coronal attachment, minimizing tooth reduction. One disadvantage is that maintaining hygiene below the attachment can be more difficult. Their main application is for distal extension prosthesis. They may be used to retain restorations for bounded spaces (**Prabhakar et al., 2012; William et al., 2014; Prasad et al., 2016).**

Most extracoronal attachments have some type of resiliency (stress redirectors). Even with resilient attachments, double abutting is recommended whenever possible. Patients are instructed on the use of dental floss and hygiene accessories as it is more difficult to maintain hygiene (**Nigam et al., 2013).**

Figure 1.8: Extracoronal attachment Crowns with attachment (C. W. Barclay, 2001)

Extracoronal resilient attachments (ERAs) have demonstrated appropriate mechanical resilience, retention and stability. The main advantage of ERA attachments, when compared with conventional clasp retained removable prostheses, are their esthetics, by eliminating the use of buccal/facial clasps of the RPDs thereby making the retentive design of the prosthesis invisible. In addition, when compared to implant-supported prostheses, removable partial dentures

retained by ERAs have lower costs and a shorter time span for fabrication **(**Figure 1.9) **(Cristian Schuh et al., 2013).**

The ERA system includes retention elements in 4 colors representing levels of resiliency. The white component provides the least retention; however, it is the most widely used component because its retention is sufficient to retain the RPD and if after a period of time, the prosthesis requires increased retention, the component could be changed using a less resilient replacement patrix **(Wang et al., 2011).**

Figure1. 9: Fixed prostheses including the female ERA attachment (a) and male ERA attachment with white nylon retentive component (b) (Cristian Schuh et al., 2013)

Stud Type Attachments: Most of the stud attachments are simple in design, consisting of a male stud type that is soldered to a base. The base is a coping covering the prepared tooth stump, usually having a post extending into an endodontically treated root canal. Fixation is achieve by a female housing that is either embedded in the acrylic of an overdenture or soldered to a substructure in the overdenture. The female housing can be rigidly attached to the male &classified as a non-resilient attachment. It could also be designed with a spring load or some other engineered style to provide for a controlled movement &therefore be classified as a resilient attachment **(Kakar, 2001; Prasad et al., 2014; Al qutaibi, 2016).**

Stud attachments are divided into two group figure (1.10): **(Prasad et al., 2014).**

1. **Extraradicular stud attachment** in which the male element projects from the root surface of the preparation or implant.
2. **Intraradicular stud attachment** in which the male element forms part of the denture base &engages a specially produced depression within the root contour or implant.

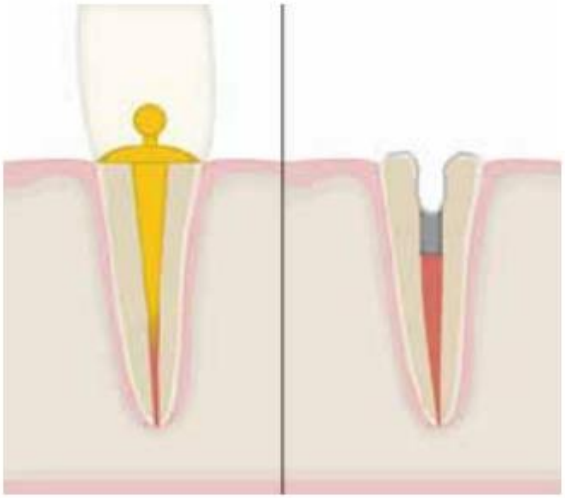

Figure 1.10: Root face attachments: extra-radicular and intra-radicular. (Gareth Williams, 2014)

Stud attachment include O-ring, ball, ERA and locater attachment (Figure 1.11). **(Al qutaibi, 2016).**

Figure 1.11: Attachments evaluated from left to right: ERA, Saturno O-ring, Locator, Ball (Al qutaibi, 2016).

Bar Type: Bar type attachments span an edentulous area and connect abutment teeth, roots, or implant. The removable bridge, partial denture, or overdenture fit over the bar and are connected to it with one or more retention sleeves, riders/ clips, or retentive plungers **(Mishra et al., 2021).**

The bar and clip attachments are probably the most widely used attachments for implant tissue supported over dentures as they offer greater mechanical stability and more wear resistance than solitary attachments **(Kakar, 2001).**

The primary detriments of bar attachments are the need for a large prosthetic space and the risk of mucositis due to inadequate oral hygiene under the bar. Bars should be parallel to the rotation axis, be straight and be positioned 1-2 mm to the alveolar crest **(Hindustanwala et al., 2019)**.

Bar attachments is sub classified into: Hader bar **figure (1.12),** Dolder bar, Andrews bar, Ceka bar, Octalink, C.M. bar, M.P. Channels, Ackerman bar, Customized bars **(Prasad et al., 2016).**

Figure 1.12: Hader Bar Attachment System (Dentaltown, 2023)

1.9.3. Based on function or movement:

Solid/rigid: When metal-to-metal contact of the patrix matrix restricts the relative movement between the abutment and prosthesis during the functional loading (of the removable partial denture), the attachment is said to be rigid. Rigid attachments are those that theoretically allow no movement of their component parts during function. However, even under the best of condition, minute movement of the prostheses will occur when occlusal forces are applied. These attachments are usually used in bounded saddle situations where the abutment teeth fully support the restoration and attachment, and soft tissue does not give any support Figure (1.13) **(Arti et al., 2018).**

Thus solid or rigid attachment any attachment employing a mechanical locking action with the use of clasps, lingual arms, springs, ball and sockets etc. The removable partial denture is held firmly in place and the abutment teeth are subjected to all of the forces in the mouth at all times (**Khanam et al., 2014).**

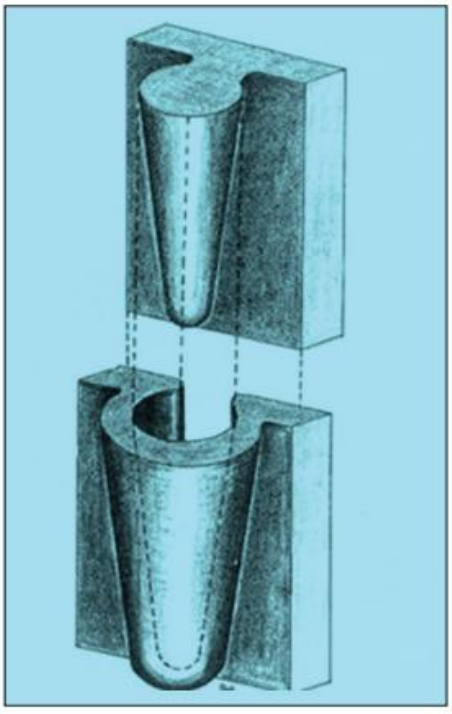

Figure 1.13: Rigid attachment (Arti et al, 2014)

Resilient: Abutment/tooth and tissue-supported restorations are considered resilient. Many attachments are designed to permit movement of the denture base, and during functional loading, these attachments are considered to be resilient attachments. Functional movement of the prosthesis may be restricted to defined vertical, horizontal, and/or rotational path, or omnidirectional displacement of the prosthesis may be permitted (Figure 1.14) **(Arti et al., 2014).**

Resilient attachment Provide a defined amount and direction of movement of their components permitting movement of the denture base toward the tissue under function while theoretically minimizing the amount of force being transferred to the abutment teeth And these movement found in two type :

- Hinged motion; allowing movement along one plane.
- Rotary motion; allowing movement along many planes. **(Mishra et al., 2021).**

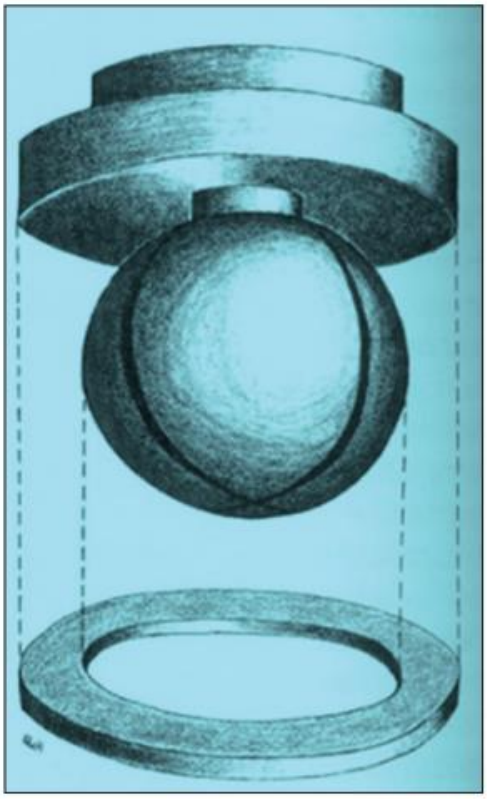

Figure 1.14: Resilient attachment (Arti et al, 2014)

1.9.4. Based on modes of retention:

The attachment is classified according modes of retention into:

(Arti et al., 2018)

- **Frictional:** Frictional retention is resistance to the relative motion of two or more surfaces in intimate contact with each other.
- **Mechanical:** Mechanical retention is resistance to the relative motion of two or more surfaces due to a physical undercut.
- **Frictional and Mechanical:** Frictional and mechanical retention combines both features of frictional and mechanical retention.
- **Suction types:** Suction is a force created by a vacuum that causes a solid object to adhere to a surface. An example would be a well-fitting denture.
- **Magnetic:** Magnetic retention is the resistance to movement caused by a magnetic body that attracts certain materials by virtue of a surrounding field of force produced by the motion of its atomic electrons and the alignment of its atoms. Magnets do not provide lateral stability and are contraindicated for flat ridges. It is used in limited applications, heat curing will weaken magnets, and they are liable to corrode.

Magnet attachments Magnetic retention is a popular method of attaching removable prosthesis to either retained roots or osseointegrated implants, the magnet is usually cylindrical or dome shaped attached to the fitting surface of the acrylic resin base of the over denture. The magnetic keeper casted to a metal coping cemented to root surface or screwed over the implant fixture (Figure 1.15) **(Al qutaibi, 2016).**

Basically, they comprise of one magnet appended to the denture and another to the implant. They comprise a simple and comfortable framework for

the patient as magnet attraction guides the denture insertion. Then again, they have a flimsier lateral stability and retention in comparison with mechanic attachments as ball or bar devices **(Hindustanwala, 2019).** They are susceptible to corrosion by saliva, explaining why they are clinically less often-used **(Tokuhisa et al., 2003).**

A new generation of rare-earth magnetic attachments could improve their properties and be clinically more often utilized These new attachments may even now be a useful treatment option for edentulous patient with weak muscle disease such as Parkinson's disease patients, because they not only keep the denture stable, but also need less force to insert and remove the denture **(Alqutaibi, 2016).**

The immediate loading of magnet attachment-retained mandibular implant overdentures is considered as a viable treatment option in cases of complete edentulous patient that increase retention and stability of conventional dentures **(Pae et al.,2010).**

Figure 1.15: Magnetic attachment (Al qutaibi, 2016).

1.9.5. Depending on the geometric configuration and design of the attachment system.

Key and keyway Figure (1.16), Ball and socket, Bar and clip or bar and sleeve. Telescope, Hinge, Push button, Latch, Screw units and Interlock **(Prasad et al., 2016).**

Figure 1.16: key and keyway attachment (Shenzhen Futeng Dental Lab Co., Ltd. , 2012)

One type of the attachment based on geometric configuration and design is **Telescopic attachment** are also known as a double crown, crown and sleeve coping (CSC). Which have been used for several years in oral rehabilitation of patients with advanced periodontal disease. Patients with periodontal disease undergoing prosthetic reconstruction often present with teeth with minimal supportive tissue and increased tooth mobility. 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 Figure (1.17) **(Klemetti et al., 2003; Alsiyabi et al., 2005).**

These retainers give fantastic retention coming out because of frictional fit between the crown and the sleeve. Telescopic retained restoration has the advantage of the ease of removability, this encourages the patient for repeated

cleaning and maintenance purposes. Moreover, the over dentures self-finding mechanism in telescopic constructions facilitated prosthesis insertion which considerably seemed to be an effective treatment modality for geriatric patients with serious systemic diseases as in Parkinson's diseases **(Langer et al., 2000).**

Figure 1.17: Telescopic attachment (Shenzhen sunflower Dental lab. Co. Ltd, 2020)

1.10. Another Classification of precision attachment:

Attachments are classified according to how they work in prosthetic designs into

- Class 1A—solid, rigid, non-resilient
- Class 1B—solid, rigid, lockable
- Class 2—vertical resilient
- Class 3—hinge resilient
- Class 4—vertical and hinge resilient
- Class 5—rotational and vertical resilient
- Class 6—universal, Omni-planer. **(Bambara et al., 2012).**

1.11. Materials used in fabrication of precision attachment:

- Precision attachments are milled from high noble metals and must be cast to high noble metal frameworks. They are obtained as finished products ready for the laboratory to use. Their tolerances are so precise that errors in the casting process may prevent the final prosthesis from fitting well. While Semi-precision attachments can be cast in semi-precious or basemetal their tolerances are not as precise as those of their precision counterparts **(Bambara et al., 2012).**

- If the components are fabricated in metal using low- tolerance, precision manufacturing techniques, the intracoronal direct retainers are considered precision attachments. Both the matrix and patrix of a precision attachment are machined from wear-compatible metal **(Phoenix et al., 2003).**

- Variety of plastic patterns are available for the fabrication of intracoronal semi- precision attachments. Figure (1.18) **(Phoenix et al., 2003).**

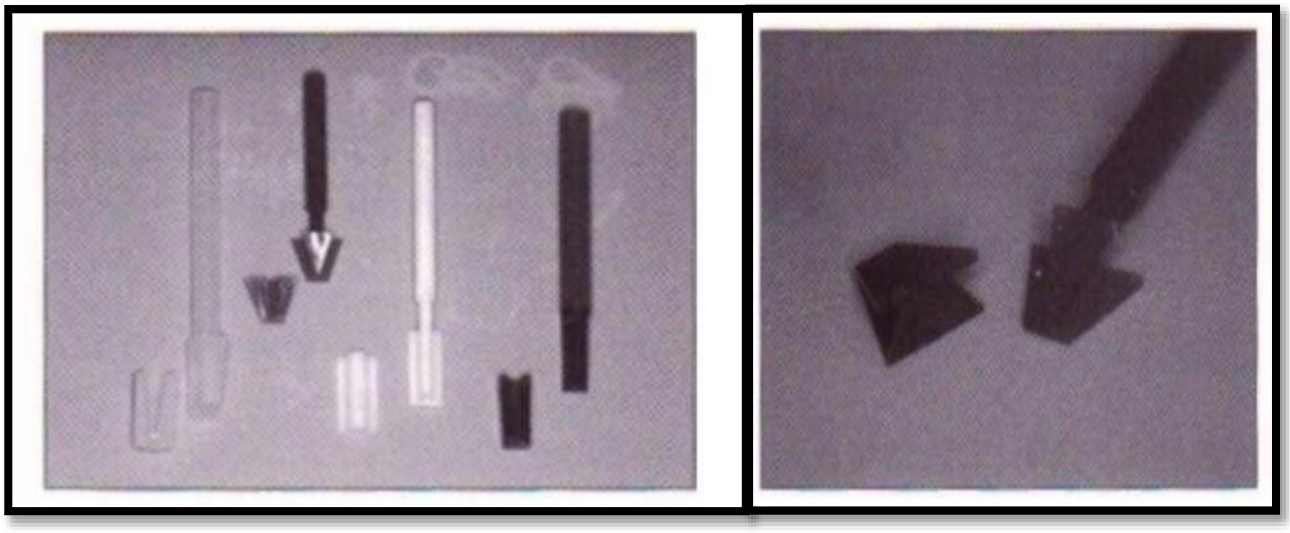

Figure 1.18: Variety of plastic materials (phoenix et al, 2003)

- Magnet used nowadays Samarium cobalt (Sm -co), Neodymium iron boron (ND-Fe-B) – 20% strong per unit volume than the cobalt – samarium alloy, Samarium-iron-nitride **(Jain et al. 2017).**
- Materials employed to fabricate precision attachments include platinum is a popular material used in precision attachment due to its biocompatibility, strength, and durability. It can withstand the forces of mastication and resist corrosion, making it an ideal choice for long-term use **Figure (1.19),** Gold is another material that is frequently used in precision attachment due to its ductility, biocompatibility, and aesthetic qualities. It can be easily cast and adjusted to fit precisely onto the abutment tooth, ensuring a comfortable fit **Figure (1.20).** And iridoplatinium for those precision attachments that are ready to use (**Mattoo et al., 2014).**

Figure 1.19: Platinum precision attachment (Global dental solution, 2021)

Figure 1.20: Gold precision attachment (Global dental solution, 2021)

- Clinical interest in zirconia has rapidly increased with development of newer CAD– CAM systems. Currently zirconia as dental restorative material is becoming the main choice for clinicians. Zirconia has excellent mechanical properties. Flexural strength measuring up to 900–1200 MPa and Hardness up to 1200 HV have been reported. **Figure (1.21)** showed the application of a CAD–CAM milled single unit zirconia anterior bridge with extracoronal attachment at its distal ends to retain cast metal partial denture prosthesis in two Kennedy's class III partially dentate patients. **(Anusavice et al., 2013; Basutkar et al., 2019).**

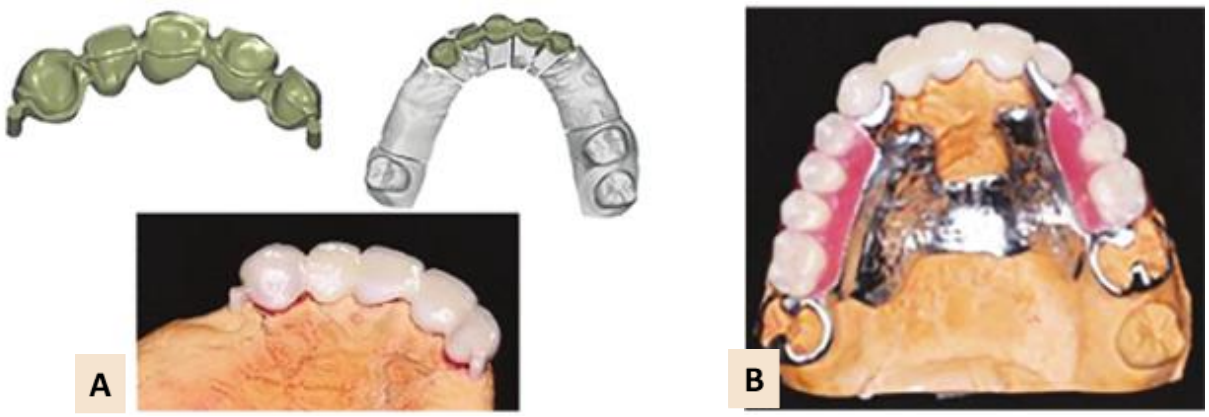

Figure 1.21: a) Computer-aided designing of the zirconia (zirCAD, Ivoclar) b) final prosthesis on the cast (Basutkar, Aljohani, et al., 2019)

- Research and clinical applications in implant dentistry had 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. Newer materials can be integrated with overdenture attachment systems. Recently, polyether ether ketone (**PEEK**) have been widely used in implant and restorative dentistry, post-core PEEK with polyvinylsiloxane (**PVS**) attachments may comprise an excellent alternative attachment system in dentistry **figure (1.22)**. They exhibits the stability, retention force and an

economical chairside technique **(Ping Li et al., 2020).**

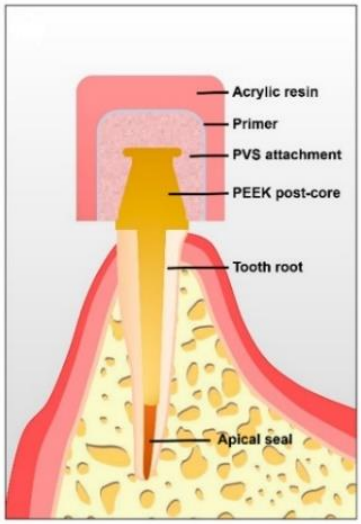

Figure 1.22: Diagrammatic representation of PEEK post-core restoration with a PVS attachment system. (Li et al., 2020)

1.12. Indications of precision attachments

Precision attachment indicated in cases that required the following: **(Bambara et al., 2012; Rani et al., 2016; Jain et al., 2017; Arti et al., 2018)**

1. Esthetics zone.
2. Redistribution of forces required.
3. Minimize trauma to soft tissue.
4. Control of loading and rotational forces.
5. Nonparallel abutments present.
6. Segmenting of the long span bridges.
7. Future salvages efforts.
8. Improved retention.
9. Movable joints in fixed movable bridge work.
10. As stress breaker in free end saddles and bridges.
11. Intracoronal attachments as effective direct retainers for removable partial dentures.

12. As a connector for sectional dentures.

13. Sections of a fixed prosthesis may be connected with intracoronal attachments.

14. To lock a connector joining saddles in the opposite side of the arch.

15. As contingency devices for the extension or conversion of existing dentures.

16. Where fixed dentures are contraindicated due to periodontal condition.

17. To retain hybrid dentures.

1.13. The contraindication of precision attachments

Contraindications to using attachments in treatment planning are poor oral hygiene, Poor Manual dexterity, dry mouth, insufficient number of abutment teeth that can be splinted if necessary, and cost. (**Bambara et al., 2012)**

The following contraindication related to the condition of patient:

(Phoenix et al., 2003; Rani et al., 2016; Arti et al, 2018)

1. Sick and the senile (prosthesis with attachments must be inserted along one precise path of insertion; the patient must possess an average degree of manual skill).
2. Patients with severe periodontitis.
3. Abnormally high caries rate Such as patients take Medications that cause dry mouth are always a serious concern because patients lack salivary flow raising the caries index.
4. Inadequate space to employ them (teeth that are very narrow faciolingually).
5. Poor neuromuscular coordination and in neuromuscular disorders.

1.14. The advantages of precision attachments

Precision attachments, allow prosthesis to combine the advantages of fixed &removable restorations. The following advantages are listed below:

(Angadi et al., 2012; William et al., 2014, Jain et al., 2017; Arti et al., 2018)

1. The potential to improved esthetics and elevated psychological acceptance.by avoiding visible retainers in the aesthetic zone **Figure (1.23).**
2. Compared to conventional clasp retained partial denture, they give better retention and stability, less liable to fracture than clasp, less bulk, and reduced incidence of secondary caries.
3. Lateral forces in the abutment during the insertion and removal are eliminated and more axial force during functions are achieved
4. Cross arch load transfer/force transmission and prosthesis, stabilization may also be improved with attachments particularly when rigid precision attachments are used.
5. Precision attachments provide better vertical support and better stimulation to the underlying tissue through intermittent vertical massage.
6. In case of distal extension base, removable partial denture prosthesis attachment positioned between the abutment and extension bases incorporates broken stress philosophy that limits the potentially damaging forces (stress transfer) imparted to the abutment as these attachments permit vertical, horizontal/rotational movement of the denture bases during function relative to the abutment.

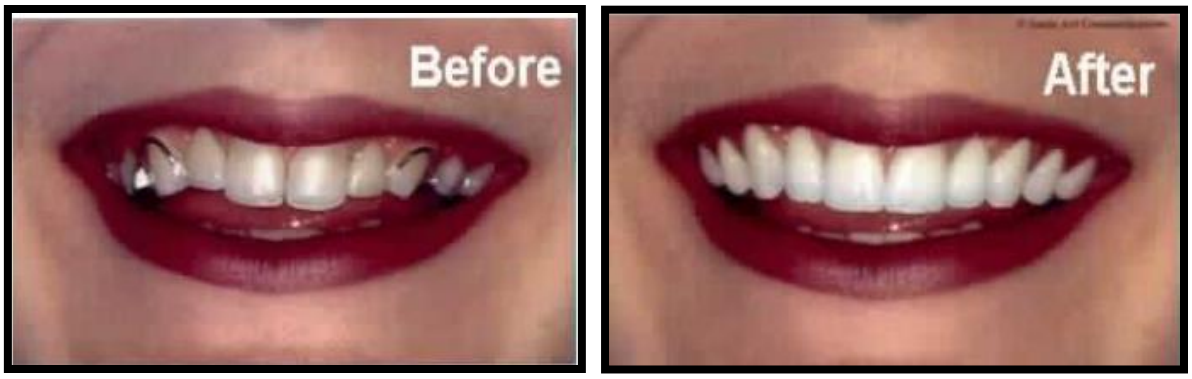

Figure 1.23: Improved Aesthetics with Precision Attachments (Reeta et al., 2017)

1.15. Disadvantages 0F the precision attachment.

The main disadvantage with extracoronal attachments is that more space is required within the removable partial denture as they are bulky. In addition the following disadvantage are: **(Angadi et al., 2012; William et al., 2014, Jain et al., 2017, Arti et al., 2018)**

1. Complexity of design, complex principles, and procedures for fabrication and clinical treatment.
2. Expensive increased overall cost of the treatment.
3. Increased demand on oral hygiene performance.
4. The tooth may have to be extensively prepared to provide required space to accommodate intracoronal attachment. If space for the attachment is not assessed appropriately then plaque control can be difficult for patients. A minimum 4 mm of vertical interocclusal space is required for most attachment systems.
5. The attachment is subjected to wear as a result of friction between metal parts; as wear occurs, male portion fits more loosely, thus permitting excessive movement leading injury to abutment teeth
6. The extra coronal type of retainer extends out from the tooth near the gingival border, so there may be gingival irritation followed by usual inflammatory sequel.

1.16. Clinical application of precision attachment:

Precision attachments can be used in various situations for rehabilitation. Some of these are outlined below:

1.16.1. Precision attachment-retained overdentures

Edentulism is considered a poor health outcome and may compromise the quality of life. The prosthetic management of the edentulous patient has long been a major challenge for dentistry. The classical treatment plan for the edentulous patient is the conventional complete denture. However, this treatment has several complications that occur more frequently on the lower denture; this led the researchers to focus more on the mandibular jaw. Therefore, the problem of stability and retention of a complete denture is partially solved with the use the attachment-fixation overdenture which is far superior to other types of overdentures or other forms of overlay prostheses Figure (1.24) **(Al qutaibi, 2016).**

The selection of the attaching mechanism for an implant retained overdenture depend on: Cost effectiveness, amount of retention needed, expected level of oral hygiene, amount of available bone, patient's social status, patient's expectation, maxillomandibular relationship, inter implant distance, and status of the antagonistic jaw **(Trakas et al.,2006).**

Examples of most commonly used precision attachments for overdentures are **stud attachment** include Dalla Bona, Gerber, Ceka, and Rothermannn. **Bar attachment** include Dolder bar, Hader bar, Andrews bar, Ceka bar and Ackerman bar. **Magmatic**, and **telescopic attachments (Rani et al., 2016).**

Figure 24: Mandibular Overdenture with Dolder Bar (Prasad et al., 2014)

1.16.2. Precision attachments for removable partial dentures

To address the condition of partial edentulism, tissue-supported prostheses alone do not treat the functional and esthetic requirements. In such situations, implant-assisted prosthodontics has become contemporary choice of replacement of the natural teeth. However, implant therapy may not be used to replace missing natural teeth for some patients. Although the attachment retained fixed removable partial denture (RPD) is not used as widely as the clasp- retained type, it is not an outdated treatment modality in dentistry. Rates of unsuccessful treatment for clasp retained cast RPDs range from 3% to 40% with mean being 26%. Studies have shown a survival rate of 83.35% for 5 years, of 67.3% up to 15 years, and of 50% when extrapolated to 20 years for attachment-retained cast partial dentures **(Thumati, Prafulla, 2016).**

Precision attachments for removable partial dentures include: **Extracoronal attachments** like Spang stabilex and conex, Crismani resilience joint, Dalla bona resilience joint, and Steiger axial rotation joint. **Intracoronal attachments** like Ceka attachment, Telescope Studs (Push Button Attachments), Gerber retention cylinder, and Dalla bona cylindrical anchor **(Rani et al., 2016).**

1.16.3. Precision attachments in fixed prosthodontics

Precision Attachments are also used in fixed prosthodontics. They are employed to reduce the size of a splint for ease of parallelism and for ease of cementation. **Stress-Breaker, Dovetail**, **Rod and Tube Attachments used** for Unparallel Bridge Abutments when the abutments either prepped teeth or implant abutments are not parallel and require an attachment for independent seating of the crown and/or bridge Figure (1.25) **(Rani et al., 2016).**

Figure 25: Rod and Tube Attachments (Global Dental Solutions2022)

Chapter Two
Conclusion

Chapter Two
Conclusion

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1. Use of precision attachment has improved the retention and esthetic aspect, of the prosthesis when compared to conventional Type.

2. Various type of precision attachment offers various options to the uses of this component as a direct retainer in prosthesis with many cases and condition that faced the dentist.

3. Various types and materials of Precision attachments serve the function of retention, stress distributions, and esthetics successfully providing that the case is planned based on sound biological and technical grounds, and proper care is rendered by the dentist and the patient during the maintenance phase.

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