REVIEW ARTICLE

Precision Attachments in Prosthodontics: A Review

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ABSTRACT

Many edentulous patients experience problems with their dentures and removable partial dentures, especially the lack of stability and retention together with a decrease in chewing ability, to overcome this problem and the desire to balance between functional stability and cosmetic appeal give rise to the development of Precision attachments also known as connecting link between the fixed and removable type of partial dentures because they incorporate features common to both types of construction.

Keywords: Frictional attachments, Internal attachment, Parallel attachment, Precision attachment.

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INTRODUCTION

The precision attachment is sometimes called as a connecting link between fixed and removable partial dentures as it incorporates features common to both types of construction. An attachment is defined as "A mechanical device for the fixation, retention, and stabilization of prosthesis". Precision attachments are two precocious metal components which 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 or the second component of patrix, is attached to the removable partial denture. They are designed to replace occlusal rest, bracing arm, and retaining arm of the conventional clasp retained partial denture [Figure 1].[1,2]

Synonyms

Internal attachments, frictional attachments, slotted attachments, parallel attachments, and key and keyway attachments.[3,4]

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Indications[2,3]

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.

Contraindications[3]

1. In patients who are sick and the senile (prosthesis with attachments must be inserted).
2. Along one precise path of insertion, the patient must possess an average degree of manual skill.
3. Patients with severe periodontitis.
4. Patients with abnormally high caries rate.
5. Where there is inadequate space (teeth that are very narrow faciolingually).

Advantages[1,5]

1. Improved esthetics and elevated psychological acceptance of the prosthesis → conventional clasp assemblies and rests may be visible and unaesthetic. Clasp arm direct retainers placed on canine and premolar abutments may be esthetically objectionable, and appropriate use of attachments may eliminate the need for facial clasp arm and improving esthetics.
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 is achieved as force application is more close to the fulcrum of the tooth than in case of occlusal rest or incisal rest; therefore, decreased lever arm reduces non-axial loading and decreases torquing forces and rotational movement of the abutment.
4. Cross arch load transfer/force transmission and prosthesis stabilization may also be improved with attachments particularly when rigid precision attachments are used.
5. 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.
6. Precision attachments provide better vertical support and better stimulation to the underlying tissue through intermittent vertical massage.

Disadvantages[1,6]

1. Complexity of design, complex principles, and procedures for fabrication and clinical treatment.
2. Expensive increased overall cost of the treatment.
3. Requires high technical expertise for successful fabrication experience and knowledge on the part of dentist and laboratory technician are essential.
4. Increased demand on oral hygiene performance.
5. The tooth may have to be extensively prepared to provide required space to accommodate intracoronal attachment.
6. 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.

CLASSIFICATION[1,2,4]

1. Based on their method of fabrication and the tolerance of fit between the components
   a. Precision attachment (prefabricated types): A precision attachment is fabricated from milled alloys. They are generally intracoronal and non-resilient. Their advantages include consistent quality, controlled wear, and easier repair. They have standard parts which are interchangeable.[2]

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.

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.[5]

   b. 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.
2. According to their relationship to the abutment teeth [Figure 2]:
   a. Intracoronal/internal attachment: If the attachment resides within the body/normal contours of the abutment teeth.[7]
   b. Extracoronal/external attachment: If the attachment resides outside the normal clinical contours of the abutment crown/teeth.
   c. Radicular/intraradicular stud type attachments: These attachments are connected to a root preparation. The female or male is soldered or cast to a root cap coping.

The female element of intraradicular stud type attachments fits within the root form contour. Examples: Swiss Logic, Zest, and the ZAAG. Some stud type attachments, such as the Uni- Anchor and the Direct O-Ring are directly cemented into the prepared root without requiring a cast coping. Stud type titanium implant attachments are also available to screw directly into implants or tissue extensions.

   d. 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.
3. Based on function or movement
   a. 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 [Figure 3].

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. The amount of movement will increase with wear of component. 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.

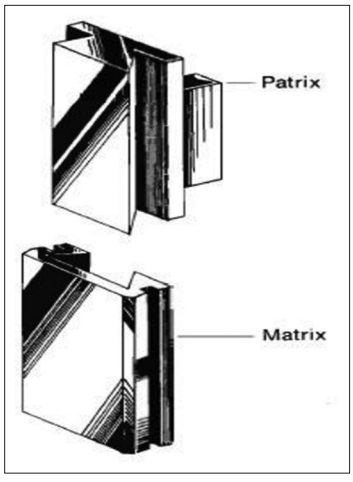

Figure 1: Components of precision attachments

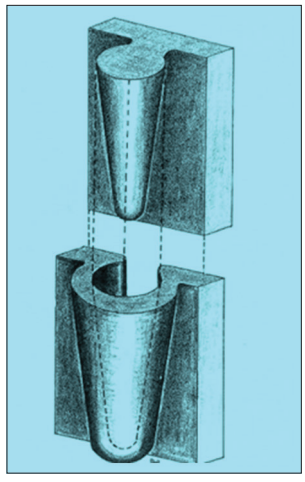

Figure 3: Rigid attachment

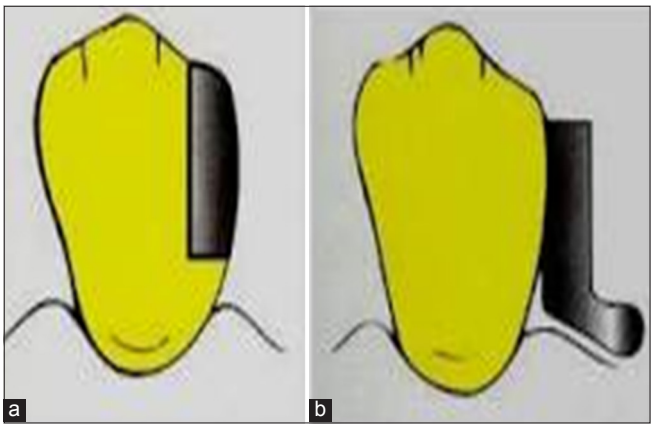

Figure 2: (a) Intracoronal attachment (b) Extracoronal attachment

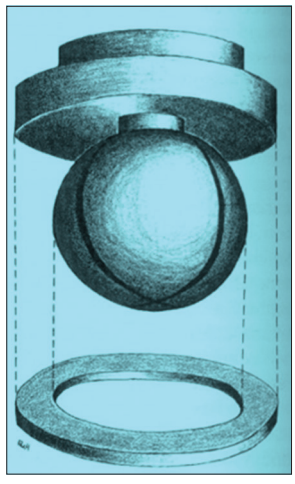

Figure 4: Resilient attachment

Subclassified into a two types: Non-lockable and lockable

b. 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 4].

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.

Hinged motion - Allowing movement along one plane.

Rotary motion - Allowing movement along many planes

4. Based on modes of retention
   a. Frictional: Frictional retention is resistance to the relative motion of two or more surfaces in intimate contact with each other.
   b. Mechanical: Mechanical retention is resistance to the relative motion of two or more surfaces due to a physical undercut.
   c. Frictional and Mechanical: Frictional and mechanical retention combines both features of frictional and mechanical retention.
   d. 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.
   e. 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.
5. Depending on the geometric configuration and design of the attachment system.
   a. Key and keyway.
   b. Ball and socket.
   c. Bar and clip or bar and sleeve.

d. Telescope.
e. Hinge.
f. Push button.
g. Latch.
h. Screw units.
i. Interlock.

Classification used in Literature

1. MC Mensor (1973): An attachment classification according to shape, design, and primary area of utilization of attachment [Table 1].
2. Gerardo Beccera and others (1987)
   a. Intradental attachment
      • Frictional
      • Magnetic[12-14]

   These are contained in part within the crown or root structure of a natural tooth.
   b. Extradental attachments.
      • Cantilever attachment.
      • Bar attachment.
3. Good kind and Baker (1976)[8-10]
   a. Intracoronal
      • Resilient.
      • Non-resilient.
   b. Extracoronal[11]
      • Resilient.
      • Non-resilient.

Mechanism of Action

Retainers must hold the prosthesis securely in place during chewing, swallowing, speaking, and other oral functions. Therefore, male and female portions must fit preciously.

Resistance to separation within the attachment is done by following mechanisms:

1. Friction.
2. Binding.
3. Wedging of conical bodies.
4. Internal spring loading.
5. Active Retention.

Selection of Attachments[1-3,6,15-17]

There are a few criteria that help to decide the appropriate attachment based on the individual need of the case.

Table 1: According to MC mensor

Coronal	Radicular	Accessory
Intracoronal	Telescope	Auxiliary
Extracoronal	Pressure buttons	Screw units
	Bar attachment	Bar connectors
	Bar joints and bar units	Bolts
		Stabilizers
		Balances
		Interlocks

1. Based on Location: Intracoronal attachments, extracoronal attachments, and radicular/intraradicular stud type attachments, bar type.
2. Based on function: It is important to differentiate between a solid and resilient-type restoration.
3. Based on modes of Retention: They are frictional, mechanical, frictional and mechanical, magnetic and suction types.
4. Space: The space available vertically, buccolingually, and mesiodistally plays a key role in attachment selection.

The vertical space is measured from the tissue to the marginal ridge or from the margin of the abutment to the marginal ridge of the opposing dentition. Use the full length of the attachment, whenever possible, and place it as low as possible without impinging on the tissue.

Buccolingual or labiolingual space is very critical, especially with removable partial dentures. It should be measured accurately to avoid over contouring the restoration in this dimension. An additional 1 mm should be added to the buccolingual measurement for metal precision attachments to allow for the casting alloy. It is best to set the teeth before the selection of an attachment. This will aid in the size determination and exact position of the attachment.

Mesial-Distal measurements are critical for intracoronal attachments since a box preparation is required. To avail maximum use, select the largest attachment possible for the space available.

5. Cost: Cost is directly related to the type and material of attachment selected.

In 1971, 126 attachments were listed and classified by Dr. Merrill Mensor; this is called as E. M. attachment selector.

It has 5 charts giving specification as to type, vertical dimension (minimal and maximal), whether it is for anterior and posterior teeth, whether the assembly is simple or complex, whether the function is rigid or resilient, type of resilience, size of movement, and type of retention. It shows if the attachment is interchangeable or replaceable and finally what type of alloy and material it is made of.

In Selecting an Attachment System for a Removable Partial Denture

1. The first decision that must be made is whether to use an intracoronal or extracoronal attachment.
2. The second decision to be made is whether to use a resilient or a non-resilient type.
3. The third consideration is that the largest attachment can be used within the given space should be chosen to gain maximum stability, retention, and strength for the prosthesis.

Intracoronal versus Extracoronal Attachment

1. Decision to use an intracoronal or extracoronal attachment depends on size and shape of the abutment teeth.
2. Intracoronal attachment requires more teeth preparation and tooth reduction than extracoronal attachment.
3. If intracoronal attachments are used where there is insufficient space, the abutment retainer will be over contoured on the proximal surface resulting in restoration that can create periodontal problems. In case the space is adequate, intracoronal attachment is preferred as they direct the forces along the long axis of abutment teeth.
4. Although extracoronal attachments are employed in areas of inadequate space, they can create areas which may be difficult to clean leading to maintenance problems. The lever arm associated with extracoronal attachment may not direct all force along the long axis of teeth.

Resilient Versus Non-resilient Attachment

Major differences of philosophy regarding the use of resilient or non-resilient attachment system occur when dealing with distal extension edentulous situation.

Theoretically, resilient attachment allows the functional forces to be directed to the tissues and alveolar ridge, and the non-resilient attachment primarily directs the vertical functional forces to the abutment teeth. Realistically, there is some sharing of function at loads in both systems.

EM attachment gauge Matsuo in 1970

Developed a color-coded millimeter gauge to define the vertical clearance available in the edentulous region of occluded casts for attachment selection. The gauge is made up of plastic and measures 75 mm in length. It is graduated from 3 to 8 mm in 1 mm increments with a corresponding color.

1. Red → 3–4 mm.
2. Yellow → 5–6 mm.
3. Black → 7–8 mm.
    - EM gauge is placed between the occluded casts adjacent to the tooth that will carry an attachment. The measurement is then read both numerically and according to the color.
    - It also gives information about where the particular attachment can be used (in terms of anterior or posterior regions and in different classes of partially edentulous arches). All these information are given in chart form which is different for intracoronal and extracoronal attachments [Figure 5].

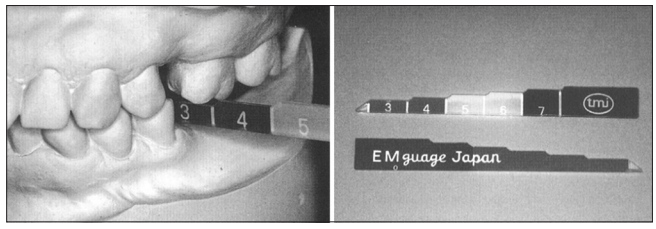

Figure 5: EM attachment gauge and selector card

Advantages

1. Provide the logical means of attachment selection based on measurements of function desired.
2. EM attachment selector and gauge afford a direct line of communication between the dentist and the laboratory technician.

Although there are few scientific data to aid in attachment selection in removable partial denture, there are some prosthodontic principles that should be used.

- Whether the prosthesis uses clasps or an attachment is that forces should be widely distributed to all available tissues.
- The denture base of tooth/tissue-supported removable partial dentures should be extended to cover the entire residual ridge within the limitation of functional muscle movements.
- The teeth and denture-supporting area should both be used to provide support, bracing, retention, direct-indirect retention, and stability. If one of these tissues is incapable of providing these functions, other restorations (e.g. complete dentures or a restoration using dental implants) should be considered.
- It is important that the removable partial denture framework can be properly related to the teeth and the denture base to the framework. This principle is satisfied if the entire framework is rigid and the framework contacts three or more teeth, preferably widely separated and with rest seat preparations.

Contact of the framework with only two abutment teeth is inadequate if there is no other way to positively relate the framework to the teeth. If a resilient attachment is used, there must be additional contact between the framework and the abutment teeth other than the attachments themselves, or there must be a way to deactivate the attachment, making the prosthesis rigid and thus allowing evaluation of the relationship between the base and the residual ridge.

CONCLUSION

The precision attachment in combination with other aspect of advanced partial denture construction offers us the possibility of making prosthesis that are esthetic , retentive ,strong and problem free and will not compromise the oral health of the patients. The clinicians

who familiarize himself with precision attachments will add new dimensions to his treatment options, and this will also broaden his referral base.

The use of attachments requires a thorough knowledge of basic prosthodontic principles, appropriate training, and experience with the particular attachment used, technical skills and clinical ability, and judgment.[1,2,5]

Precision attachments present a challenge in the technical skill. A thorough understanding of the biomechanics of maxillo-mandibular function, different attachments, and knowledge of material science is essential in treating a case of precision attachment. Precision attachments serve the function of retention, stress distribution, 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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