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Attachments In Removable Prosthodontics: A Comprehensive Review

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Abstract

Precision attachments represent a vital mechanical link between fixed and removable prosthodontics, serving as direct retainers that provide fixation, retention, and stabilization for dental prostheses. Historically advanced by pioneers like Dr. Herman Chayes, these systems consist of a metal receptacle (matrix) and a closely fitting part (patrix) manufactured to precise tolerances. They are primarily indicated for enhancing esthetics in the smile zone by eliminating visible clasp assemblies, as well as for redistributing functional forces and managing non-parallel abutments. Attachments are classified based on their fabrication method (precision vs. semi-precision), relationship to abutments (intra-coronal, extra-coronal, radicular, or bar types), and functional movement (rigid vs. resilient). Rigid attachments are typically utilized in tooth-borne, bounded saddle situations, while resilient designs permit controlled movement to protect abutment teeth in distal extension cases. Retention is achieved through frictional, mechanical, or magnetic means. Despite advantages such as improved stability, axial force transmission, and psychological patient acceptance, these systems require high technical expertise and meticulous oral hygiene. They are contraindicated in patients with poor manual dexterity, severe periodontitis, or high caries rates. Long-term success relies on appropriate case selection, sound biomechanical planning, and regular professional maintenance to monitor component wear. Ultimately, precision attachments offer a sophisticated alternative to conventional RPDs, fostering both functional efficiency and emotional stability for the patient.

KEYWORDS
Precision Attachments, Removable Partial Dentures, Esthetics, Abutment Teeth, Prosthetic Retention

1 | INTRODUCTION

The precision attachment is sometimes called 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 precious 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. [1,2,3] Synonyms Internal attachments, frictional attachments, slotted attachments, parallel attachments, and key and keyway attachments. [1,4,5]

2 | HISTORY

The historical background of precision attachment work is somewhat obscure. Stair (1886) devised a unilateral RPD employing anterior and posterior telescopic abutment restoration. The most important character with the development of precision attachment dentistry was Dr. Herman ES Chayes 1906 who developed the T shaped precision attachment. 1908 – 1910 He invented a parallelometer. 1912 – Designed Chayes attachment. Ash (1912) introduced the split bar attachment system. Chayes also gave the stress breaker design which is essentially an attachment to which a hinge has been added, so allowing limited simple movement this design was later improved by McCollum. [1,5]

3 | INDICATIONS

1. Esthetic 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 salvage efforts.
8. Improved retention.
9. Movable joints in fixed movable bridge work.
10. As stress breaker in free end saddles and bridges.
11. Intra-coronal 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 intra-coronal 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. [1,3,4,6]

4 | CONTRAINDICATIONS

1. In patients who are sick and senile (prosthesis with attachments must be inserted).
2. Patients must possess an average degree of manual skill for a precise path of insertion.
3. Patients with severe periodontitis.
4. Patients with abnormally high caries rate.
5. Where there is inadequate space (teeth that are very narrow faciolingually). [1,4,6]

5 | ADVANTAGES

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.
4. Cross arch load transfer/force transmission and prosthesis stabilization may also be improved with attachments particularly when rigid precision attachments are used. [1,2,7]

6 | DISADVANTAGES

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 intra-coronal attachment. 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. [1,2,8]

7 | CLASSIFICATION

1. **Based on their method of fabrication and the tolerance of fit between the components** [1,2,3,5,6] a. Precision attachment (prefabricated types): A precision attachment is fabricated from milled alloys. They are generally intra-coronal and non-resilient. [3] 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 is 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. [7] 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:** a. Intracoronal/internal attachment: If the attachment resides within the body/normal contours of the abutment teeth.[9] b. Extracoronal/external attachment: If the attachment resides outside the normal clinical contours of the abutment crown/teeth. c. Radicular/intra-radicular 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 intra-radicular 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 and 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. 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. Subclassified into 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. 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.[15,16,17,18] 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. Coronal: Intracoronal, Extracoronal, Bar attachment, Bar joints and bar units. Radicular: Telescope, Pressure buttons, Bar connectors. Accessory: Auxiliary, Screw units, Bolts, Stabilizers, Balances, Interlocks. 2. Gerardo Beccera and others (1987) a. Intradental attachment: Frictional, Magnetic. 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)[10,11,12] a. Intracoronal: Resilient, Non-resilient. b. Extracoronal[13] Resilient, Non-resilient.

8 | FACTORS AFFECTING DURABILITY OF PRECISION ATTACHMENTS

When two or more attachments are used for the retention of a single prosthesis, durability will be affected by the position of the attachments: the paths of insertion and removal of each attachment must he aligned. A second factor influencing durability is the alloy used in fabrication of the attachment. Many manufacturers use dissimilar alloys for the matrix and patrix. Abrasion between two similar alloys would lead to equal wear of both components. The component that is intended to form part of the prosthesis is usually wrought from an alloy with a lower resistance to abrasion. Thus, wear will take place at the expense of the component which is more easily replaced rather than the one attached to the abutment tooth. A third factor in durability is the surface areas of the attachment in contact during function of the prosthesis. Where large surface areas are in contact, the rate of wear would be expected to be less than where the area is minimal. The stability of the prosthesis also affects durability. A prosthesis which is inherently stable and which is designed to be supported adequately under load will not result in undue wear of the attachment.[14]

9 | DISCUSSION

Prasad et al stated that there are many factors that come into light while considering precision attachments as an integral part of treatment. One main aspect of geriatric patients is the diminished dexterity of the patient, one which often escapes the calculations while designing the prosthesis.[3] Becerra G, Macentee M stated that the clinical situation for which an attachment is intended will place specific demands that can be met more closely if the forces acting on the prosthesis are considered. No universal or ideal design is available, so if attachments are used, they should be selected from the group with the most suitable characteristics for the task required.[4] According to Hema et al the accurate selection of attachments depends mainly on location, retention and available space. Proper maintenance and care by the patient and regular follow up decide on the long-term success of the attachment and prosthesis. Use of precision attachment strengthens the aspects of retention and particularly, esthetics when compared to conventional removable partial dentures.[6] Angadi et al stated that the success of prosthesis depends on careful treatment planning and attention to the prosthodontic problems; the mechanical ingenuity of the attachment is important but must take second place.[7] An attachment classification and compendium of attachments represented by the E. M. attachment selector and gauge has been described and discussed. The E. M. attachment selector and gauge afford a direct line of communication between the dentist and the dental laboratory in developing a meaningful work order.[9] Grosser D inferred that in many instances where few teeth remain, internal precision attachment is the only method of retaining a partial restoration and avoids the necessity for resorting to full dentures. It offers a method of denture construction conducive to emotional stability, excellent esthetics, and good masticatory function.[10] Three methods were described for casting RPD frameworks directly to intra-coronal attachments. Ford CB preferred the first method described in this article. By casting directly against the refractory cast, soldering is eliminated. The end result is a precision removable partial denture without misalignment problems.[11] Brudvik JS and Shor A stated that the creation of milled parallel surfaces in natural or restored abutment teeth, coupled with removable partial denture castings that have optimal contact with these preparations, results in a path of insertion and removal that is controlled in a manner similar to one using conventional precision attachments.[24] Remaking of a fractured RPD using round profile attachment analogs has not been reported previously. The described technique requires the placement of the prefabricated round profile attachment matrixes, so the matrixes have the same occlusal level as the round profile attachments.[40] The treatment modality as per Zahler J.M involving an ERA system and transfixation in fixed crowns, is an effective treatment and can be indicated as a clinical alternative for edentulous and partially edentulous patients with systemic disorders or for patients in economic situations that might preclude implant-based rehabilitation.[41]

10 | 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. Clinicians who familiarize themselves 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.[1,2,3,6,7] Precision attachments present a challenge in the technical skill. A thorough understanding of the bio- mechanics 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.[6]

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