

PRECISION ATTACHMENT – A REVIEW

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ABSTRACT

Precision attachments are small interlocking devices to connect prosthesis and abutments that offer a variety of solutions to the challenge of balance between functional stability and cosmetic appeal. A conservative treatment that can delay or eliminate future prosthodontic problems should be considered, as rehabilitation of a patient with few teeth remaining is challenging. Inherent instability of dentures or resiliency of the supporting tissues during functional and parafunctional movements causes movement of the denture which makes the complete denture patients unsatisfied. Precision attachment plays important role to eliminate such problems. Precision attachments have wide applications, used in fixed removable bridge, removable partial dentures, overdentures, implant retained overdentures, and maxillofacial prosthesis. Attachment retained overdentures helps in distribution of masticatory forces, minimizes trauma to abutments and soft tissues, attenuate ridge resorption, improves the esthetics and retains proprioception. Attachments are mechanical devices for the fixation and stabilization of a dental prosthesis and include frictional, internal, intracoronal, extracoronal, key-key way, parallel, precision and slotted types. (Boucher 1976). Attachments are used as alternative to clasps in removable partial denture therapy for both aesthetic and functional purpose. In this article, different systems of classification of attachments, its indications, contraindications, advantages and disadvantages have been reviewed.

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INTRODUCTION

The term precision denotes ‘the quality or state of being precise’ they are considered as a connecting link between the fixed and removable type of partial dentures. ¹Precision attachments is made up of two halves –matrix and patrix that articulate with one another and form a separable joint. ² They are also referred as male and female parts. The abutments houses a slot female) which fits, (embraces or envelops) the male portion. The precision attachment may be prefabricated by a manufacturer or in the dental laboratory³ This is differentiated by calling the former ‘precision’ and the latter ‘semiprecision’ attachments. The semiprecision attachment is referred to as ‘precision rest’ ‘milled rest’ or ‘internal rest’.⁴

History

The historical background of precision attachment work is somewhat obscure. The most important character with development of precision attachment dentistry was Dr. Herman ES Chayes 1906 – who developed the *T, shaped precision attachment*. (Fig. 1)

1908 – 1910 He invented a parallelometer.

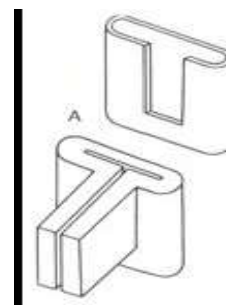


Fig1 Chayes T shaped

1912 – Designed Chayes attachment (Fig. 2.a, b). This was the first attachment to be placed on the general market and still forms the basic pattern for the modern friction grip attachments.

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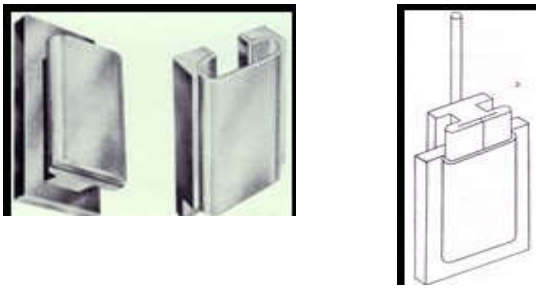


Fig 2 Chayes attachment

Late 19th century → period when there has been development of various extracoronal and intracoronal attachment systems. A number of people contributed to the development of precision attachments.

Winder – Winder constructed the first unilateral fixed detachable type of removable partial denture employing screw joint retention – called *Winders design*. (Fig.3)

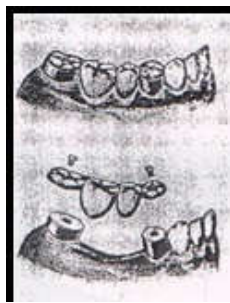


Fig 3 Winder design

Parr (1886) invented the extracoronal “socket” attachment (Fig.4) soldered to each abutment restoration adjacent to the edentulous areas that were to be restored with the removable prosthesis. Rests or gold tongue were made with strips of spring gold plate bent by practitioners, the gold tongue were fitted to “gold sockets”.



Fig4 Par extracoronal socket attachment

Stair (1886) devised a unilateral PRD employing anterior and posterior telescopic abutment restoration.

Ash (1912) introduced the split bar attachment system. (Fig. 5)

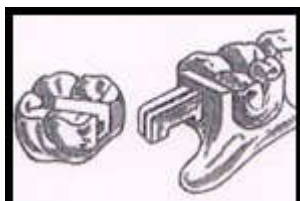


Fig 5 Ash split bar

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.

Definitions

Precision Attachment

1. A retainer consisting of a metal receptacle (matrix) and a closely fitting part (patix). The matrix is usually contained within the normal or expanded contours of the crown on the abutment tooth and the patix is attached to a pontic or the removable partial denture frame work (Glossary of prosthodontics terms Sixth Edition 1994).⁵
2. 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 frame work (Jack H. Swepston – Dental laboratory Proceedings, Removable partial dentures – Rhoads, Rudd, Morrow).⁶

Intracoronal Precision Attachments

The bulk of the soldered or cast on portion of the joint lies within the anatomical contours of the treated teeth (G.E. Ray – Precision Attachments).⁷

Extracoronal Precision Attachments

Are used to join a prosthesis to a retainer, part of all of their mechanisms is outside the contour of the retainer (Merrill C. Mensor – Dental Laboratory Procedures, Fixed Partial Dentures, Rhoads, Rudd, Morrow).⁸

Semiprecision Attachment A laboratory fabricated rigid metallic patix of a fixed or removable partial denture that fits into a matrix in a cast restoration, allowing some movement between the components; attachments with plastic components are often called semi precision attachments even if prefabricated (not laboratory fabricated)

Indications

1. They are used as a movable joints in fixed removable bridge framework.
2. They allows some movement between the denture base or its supporting framework in free end saddles and bridges. Hence used as a stress breaker.
3. Intracoronal attachments retain and prevent dislodgment of removable partial dentures.
4. They act as a connector to join together the sectional dentures intra-orally to create a single prosthesis for their successful use in aesthetic zone.
5. Due to poor health and instability of periodontal conditions fixed partial dentures is contraindicated in partially edentulous ridges hence precision attachment is indicated.
6. Hybrid dentures, also called fixed-detachable dentures, are a way to replace missing teeth and gum tissue with a prosthetic attached to dental implants can be retained by precision attachments.

Contraindications

1. In patients who are sick and the senile
2. Patients with severe periodontal infection or severe Periodontitis
3. Patients with has abnormally high caries rate.

- Where there is inadequate or minimum space (Teeth that are very narrow facio-lingually).

Advantages

- Improves esthetics as labial and buccal clasp arm can be eliminated altogether.
- Mechanical advantage –it directs the forces along the long axis of the teeth, reduces the non axial loading and decreases torquing forces.

Disadvantages

- Complexity of design and procedures as the tooth may have to be extensively prepared to provide required space to accommodate intracoronal attachment.
- Wearing of the attachment components
- Expensive
- The extracoronal type of attachment must occupy the space immediately adjacent to abutment tooth, which is precisely where a replacement tooth should ideally be positioned.
- Increase demand of the oral hygiene performance

Classifications

Attachments are classified in a number of ways

I) Based on the method of fabrication and tolerance of fit

- Precision (prefabricated attachments)
- Semi precision (custom made) attachments

II) Precision attachments are basically classified as follows (Goodkind & Baker, 1976):

- Intracoronal
 - Resilient
 - Non-resilient
- Extracoronal
 - Resilient
 - Non-resilient

III) Based primarily on the function of the attachments: Feinberg & Feinberg, 2002

- Rigid** It employs a mechanical locking action with the use of clasps, lingual arms, springs, ball and sockets etc.
- Passive** There is a free movement of the male when the abutment teeth are exposed to excessive forces.

IV) Becerra & Mac Entee (1987)¹⁰

- Intradental Attachments
 - Frictional: That includes designs like tapered and parallel wall boxes and tubes, adjustable metal plates, springs, studs, locks.
 - Magnetic.
- Extradental
 - Cantilever
 - Bar – e.g. Ackermann bar, Dolder bar (oval cross section).

V) Mensor’sclassification (Table 1)

An attachment classification based on shape, design and primary area of utilization of attachment.

Coronal	Radicular	Accessory
1) Intracoronal	3) Telescope stud	5)Auxiliary
2) Extracoronal	4) Bar	A)Screw units
	Joints	B)Pawl connectors
	Units	C)Bolts
		D)Stabilizers
		E)Interlocks
		F)Pins/screws
		G)Rests

VI) Classification by Harold Prieskel¹¹

1. Intracoronal attachments It consist of two parts a flange and a slot. The flange is joined to one section of the prosthesis and the slot unit embedded in a restoration forming part of another section of the prosthesis.

A. Those whose retention is entirely frictional

- With adjustment potential: Constant insertion and removal of the prosthesis will cause the attachments to wear, so that some form of adjustment is desirable. e.g.:
 - Chayes attachment (Fig 6).
 - Crismani attachments.
 - McCullum unit (Fig 7).
 - Ancra attachment.
 - T-Geschiebe 123 (Fig 8)



Fig 6 Chayes



Fig 7 McCollum unit

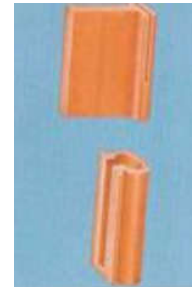


Fig 8 T-Geschiebe123

Without adjustment potential Lack of adjustment potential renders this type of unit unsuitable for removable prosthesis, as repeated insertion and removal will cause the attachment to wear. They are useful for joining a series of crowns without a common path of insertion. e.g.

- Round profiles are useful when anterior teeth are concerned.
- Beyeler attachment offers more contact surface areas in the posterior quadrants.

B. Those whose retention is augmented by a mechanical lock. e.g.: Schatzmann unit. (fig 9).



Fig 9 Additional retention is provided by a spring loaded plunger

Extracoronary attachments These attachments have part or all of their mechanism outside the crown of a tooth.

a. Projection units: These units are attached to the proximal surface of a crown. These groups can be divided in turn into

- Those that provide a rigid connection. e.g.: Conex attachment.
- Those that allow play between the components. e.g.: Ceka attachment (Fig 10), Dalbo (Fig 11)

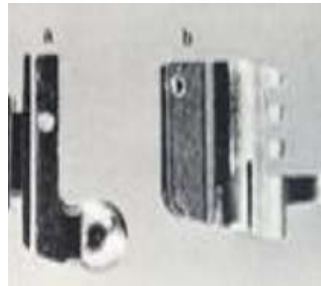


Fig 10 Ceka extracoronary attachment Fig 11 The Dalbo extracoronary attachment

b. **Connectors** These units connect two sections of a removable prosthesis and allow a certain degree of play E.g.: Dalbo-fix used between a telescope crown and partial denture.

c. **Combined units:** The attachment features an extracoronally placed hinge type unit connected to an intracoronary attachment. E.g.: Schatzmann attachment consisting of an intracoronary section with a projection.

3) **Stud attachments** are so called because of the shape of the male units that are usually soldered to the diaphragm of a post crown. They are the simplest of all attachments. Some of these units provide rigid connection while others allow movement between the two sections e.g.: Gerber, Dalbo (Fig 12), Zest, ERA, Prosnap, Profix all are stud attachments. Gerber is the largest stud unit.



Fig 12 Dalbo stud attachment

4. **Bar attachments** It consists of a bar spanning an edentulous area joining together teeth or roots. It fall into two categories-

a. **Bar joints** – allow play between the denture and the bar
 Single sleeve bar joints e.g. Dolder bar joint (Fig 13), Baker clip (available in 12 or 14 gauge bar size) Multiple sleeve joints: Hader, Ackermann (Fig 14), CM bar joints

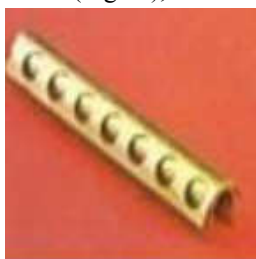


Fig 13 Dolder bar



Fig 14 Ackermann

b. **Rigid Bar units** –with these attachments the sleeve\ bar junction is rigid

5. Auxiliary attachments

- a. Screw units
- b. Friction devices
- c. Bolts
- d. Hinge flanges

Attachment Selection 12, 13

It was classified by Dr. **Merrill Mensor** called as **E. M. attachment selector (Fig 15)**. 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 utilizes a colour coded millimeter attachment gauge to define the vertical clearance available in the edentulous regions of occluded casts for attachment selection. The gauge is made of plastic and measuring 75 mm in length. It is graduated from 3 to 8 mm in 1 mm increments with a corresponding colour code.

- Red designates 3 to 4 mm,
- Yellow designates 5 to 6 mm and
- Black designates 7 to 8 mm.

The gauge is placed between the occluded casts adjacent to a tooth that will carry an attachment. The measurement is thus read numerically and according to colour.

In selecting an attachment system;

- The first decision that must be made is whether to use an intracoronary attachment,
- The second decision to be made is whether to use a resilient or a nonresilient type,

The third consideration is that the largest attachment can be used within the given available space should be chosen to gain maximum stability, retention and strength for the prosthesis.

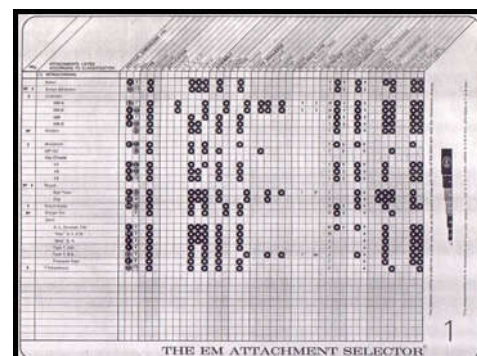


Fig 15 The EM attachment selector

Mechanism of Action¹³

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

1. **Friction** Friction occurs between contacting parallel walled bodies. It is directly related to the area of the opposing surfaces as well as to the length of axial walls. This can be enhanced by the addition of active retention elements like -Spring – loaded bolts on plungers, Leaf – springs, Ring – springs , Bolts, Rubber devices
2. **Binding** It create an additional binding effect significantly increasing resistance to withdrawal.
3. **Wedging of conical bodies**
4. **Internal spring loading** as produced by a clip within a cylinder
5. **Active Retention**

Bar Attachment

Bar attachments acts as splints, joining teeth or roots and spanning the edentulous regions between. Since the bar is positioned close to the alveolar bone supporting the teeth, forces applied to those teeth through the bar exert a far smaller leverage than those applied through an occlusal rest of a partial denture. Bar attachments fall into two groups, those allowing slight movement-the **bar joints** and the comparatively rigid **bar units**.

Bar Joints

Bar joints are those attachments allowing movement between the two components. They have their main application in overlay denture construction where two, three or possibly four teeth remain. A common path of insertion for the retaining posts is desirable although divergence can be overcome by mechanical means. Alternatively the abutment teeth can be crowned and these crowns connected by the bar.

1. **Single sleeve bar joints**
2. **Multiple sleeve bar joints**

1. Single Sleeve Bar Joints

The Dolder bar joints is an excellent example of this attachment. This well tried bar is produced from wrought wire, pear shaped in cross section and running just in contact with the oral mucosa between the abutments. An open sided sleeve is built into the impression surface of the denture and engages the bar when the denture is inserted.

2. Multiple Sleeve Joints

If several short sleeves are substituted for a continuous one, there is no need for the bar to run straight and it can be bent to follow the vertical contours as well as the antero-posterior curvature of the ridge. Gilmores original design was an attachment of this type. Ackermanns bar is almost identical

Functions Of The Bar Joint¹⁴ The bar and sleeve joint gives retention and guides the movements of the denture relative to the abutment teeth. The sleeve supplies functionally adequate retention, and when the teeth are out of contact, there is a vertical gap of about 1 mm. between the roof of the sleeve and the top of the bar .(fig.16)

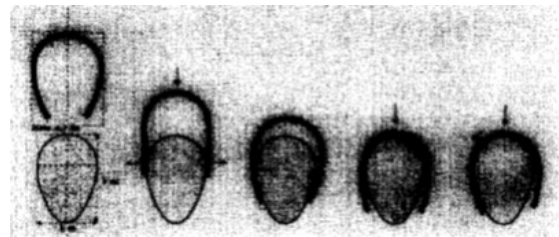


Fig 16 The bar joint in schematic cross section shows, from left to right: the parts disassembled, insertion of the denture, the position of rest, perpendicular depression of the whole denture. And rotation about the bar as an axis.

From this initial (resting) position, the bar and sleeve joint permits three possible movements of the denture:

- during vertical depression of the denture, the entire sleeve is translated toward or upon the bar,
- during unilateral depression of the denture, only the more depressed end of the sleeve touches the bar, and
- rotation about the bar as an axis is possible for approximately 10 degrees in either direction from the resting position. Rotation is limited only gradually by the elastic flanges of the sleeves

Bar Units

Bar units are comparatively rigid allowing no movement between the sleeve and bar. Although some load may be distributed to the mucosa, these prostheses are mainly tooth-borne. Bar units may be useful where:

1. There are four or more abutment teeth and large edentulous spaces.
2. The number and distribution of the teeth does not allow construction of a satisfactory clasp retained partial denture.
3. There are edentulous space with considerable resorption.
4. Rigid splinting is required of the remaining teeth or roots.
5. The appearance of the remaining natural teeth requires post preparations.

Bar units provide excellent retention and stability for a denture while rigidly splinting the abutments. Artificial mucosa can be provided by the denture flange and the removable section can be rebased or repaired like a clasp retained prosthesis.

Stud Attachment¹¹

Stud devices are among the simplest of all attachment. The male part of the unit consists of a stud- shaped projection and in the majority of the attachment it is soldered to the diaphragm of a post crown: the female part fits over the male unit and embedded within the acrylic resin of the prosthesis or soldered to a metal sub-frame. There are, however a few systems in which the male sections forms part of the denture and the female part of the root surface preparation.

Stud attachments are divided into two groups:

1. **Extraradicular**, in which the male element projects from the root surface of the preparation or implant.eg **Microfix**
2. **Intraradicular** , in which the male elements forms part of the denture base and engages a specially

produced depression within the root contour or implant e.g. **The Ceka Revax**

Indications of stud attachments

Use of the stud attachment and overlay denture is indicated particularly in those instances where there are only two isolated mandibular canines or premolars remaining. These teeth may be supraerupted and may present problems relating to the height of the occlusal plane and to esthetics. Stud attachments have also been used on patients with advanced periodontitis and hypermobility of the teeth. The stud attachment may be used in any part of the mouth for denture retention. It has been used to retain maxillofacial prostheses. It may be used in conjunction with different retentive and support devices such as a Dolder bar. The stud attachment is indicated for patients with chronic debilitating diseases such as multiple sclerosis where the patient will eventually suffer loss of muscular control. These patients encounter severe problems with the function of a complete mandibular denture; the retention provided by the attachment serves the patient well.

Other example of stud attachment are-

- Gerber
- Dalbo
- Rotherman
- Conods unit
- Baer and Fah unit
- Ancrofix
- Ceka system
- The Zest anchor system

Instructions to Patient and Recall¹⁵

Instructions to the Patient

Before the patient is dismissed, the difficulties that may be encountered and the care that must be given to the prosthesis and the abutment teeth must be reviewed.

Return for Post Insertion Adjustments

The patient should be scheduled for the first post insertion appointment 24 hours following insertion of the denture. The patient is instructed to wear the denture continuously between the first two appointments except for cleaning. After 24 hours, the patient will have some opinions regarding how the denture feels and how they function. Scheduled appointments for postinsertion adjustments will indicate to patients that there is concern for their well being and that minor adjustments will be necessary to improve the fit and comfort of the denture.

Sore Spots

The patient should be informed that sore spots may develop and that appointments are being scheduled to detect and eliminate them at the earliest opportunity. The patient should be informed that after the initial period of adjustment additional sore spots may develop from time to time, and those that persist for several days should be examined and adjusted.

Insertion and Removal

The patient should be visually introduced to the removal and placement of removable partial denture. The patient is brought in front of a mirror and asked to insert and remove the partial denture in the correct fashion several times before being dismissed.

When to Wear the Partial Denture

It is better to leave the removable partial denture out of the mouth during sleeping hours to allow the adjacent tissues a chance to rest and recuperate. When the prosthesis is out of the mouth it should be immersed in water to prevent dehydration of the acrylic resin. When the removable partial denture is not being worn, the patient should refrain from eating, since food can become impacted within the female receptacle.

Cleaning the Denture

Patients who wear removable partial denture prostheses should be encouraged to maintain meticulous oral hygiene. The teeth adjacent to the removable partial denture are especially susceptible to decay, since they no longer receive the same kind of thorough cleansing action from the cheeks, tongue and saliva. Food that accumulates between the prosthesis and the teeth must be removed after meals to prevent the potential for carious involvement. The removable partial denture should be rinsed under cool water after each meal and brushed at bedtime with a natural bristle brush along with the regular tooth brushing routine. Special partial denture brushes for cleaning inside portions of clasps and adjacent to attachments can be purchased at most pharmacies. Smokers tars that build up on the framework can be removed by immersing the denture overnight in white vinegar. More persistent stains and calculus buildup should be removed at the patient's routine recall appointment. An ultrasonic cleaner with the proper solution for stains and calculus will remove stubborn unsightly deposits.

Speech

The patient may experience some difficulty in speaking clearly at first, particularly if the maxillary removable partial denture covers all or part of the palate or anterior teeth are being replaced. The tongue may be somewhat restricted and needs time to adjust to the new environment. The condition is usually temporary and will improve rapidly, almost without conscious effort on the part of the patient. The patient who has greater difficulty can speed up the speaking process by reading aloud and repeating those sounds that are most troublesome.

Saliva

The patient may notice an excess of saliva in the first few days of wearing the partial denture. As the removable partial denture becomes a permanent part of the oral environment, the flow of saliva should decrease.

Tooth soreness or sensitivity

Teeth that have become abutments for the removable partial denture have often been out of function prior to placement of the prosthesis. Teeth that are put back into function may become sore as a result of loading and the minor orthodontic effects of the removable partial denture. The patient should be advised of this possibility. A premature occlusal contact may also be the cause. Remount procedures and occlusal adjustment are recommended at the time of insertion and subsequently with or without the symptoms of tooth soreness.

CONCLUSION

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. Precision attachments present a challenge in the technical skill. A thorough understanding of the biomechanics of maxillomandibular function, different attachments and knowledge of material science is essential in treating a case of precision attachment. Unfortunately, most often precision attachments are chosen from descriptions in manufacturer's catalogues which leads to failure of precision attachment cases. Precision attachments serve the function of retention, stress distribution and aesthetics successfully provided 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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