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ATTACHMENTS IN PROSTHODONTICS: DIFFERENT SYSTEMS OF CLASSIFICATION: A REVIEW

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ABSTRACT: Attachments are mechanical devices for the fixation and stabilisation 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. Their application is not only limited to removable partial dentures, but has a broader usage in fixed bridges, overdentures, implant supported dentures as well. Hundreds of attachments are available commercially and significant differences exist between them. In this article, different systems of classification of attachments have been reviewed. They are categorised as precision and semi-precision depending on the method of manufacture, intracoronal and extra coronal depending on their location relative to the abutment tooth, rigid and resilient determined by the amount of movement allowed between the component parts, also as stud and bar attachments depending on the design. A classification system to more accurately evaluate differences among resilient attachments has also been described here.

KEYWORDS: Key way attachment, precision attachment, extra coronal attachment, internal attachment, parallel attachment, frictional attachment.

INTRODUCTION: An attachment is a mechanical device for the fixation; retention and stabilization of dental prosthesis.¹ Attachments in one form or another have been used for many years and are not new by any means as there is evidence of wire and riveted devices dating back to the Egyptians. However, we are concerned with moderate form ranging from simple slides to sophisticated assemblies with many micro engineered parts fabricated in different alloys for different purposes.²

Steiger and Boitel (1959) write that a precision attachment in dentistry is a means of bodily junction for a removable bridge or partial denture.³ Towards the end of the 19th century Parr, Peeso, Carr, Alexander and Morgan had all designed and used simple intracoronal attachments. Griswald had designed his own attachment and an ingenious paralleling device for alignment.

In 1906, Dr. Herman E. S. Chayes designed the attachment which with modification, is still in production today and carries his name. His original idea was to position the attachment lingually, but subsequently a mesio-distal position was suggested.⁴ The demand for what might be called "fashion magazine" esthetics, so apparent in our modern society, has made many of our patients unwilling to accept visible anterior clasping and so we see an increasing need to offer this type of prosthesis.⁵

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CLASSIFICATION OF ATTACHMENTS: Attachments are classified in a number of ways:

Bases on the method of fabrication and tolerance of fit:⁶

1. Precision (prefabricated attachments): According to GPT 8:
 - A retainer consisting of a metal receptacle (matrix) and a closely fitting part (patrix); the matrix is usually contained within normal or expanded contours of the crown on the abutment tooth and the patrix is attached to a pontic or the removable partial denture framework.
 - An interlocking device, one component of which is fixed to an abutment or abutments and the other is integrated into a removable prosthesis to stabilize and/or retain it.¹

Precision attachments have prefabricated, machined components with precisely manufactured metal-to-metal parts with close tolerances of 0.001.⁶

2. Semi precision (custom made) attachments: A laboratory fabricated rigid metallic extension(patrx) of a fixed or removable dental prosthesis that fits into a slot – type keyway (matrix) in a cast restoration, allowing some movement between the components.¹ Semi precision attachments may be either manufactured patterns (made of plastic, nylon, or wax) or hand waxed.⁶

Precision attachments are basically classified as follows (Goodkind & Baker, 1976):⁷

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

Based primarily on the function of the attachments:

Feinberg & Feinberg, 2002:

1. Rigid: 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.
2. Passive: An attachment that provides a free movement of the male when the abutment teeth are exposed to excessive forces. Such a passive retention mechanism has the effect of an automatic stress breaker.⁸

Becerra & Mac Entee (1987) has described the other system of classifying the attachment to provide an overview of the designs available and to identify the common feature of each class.^{8,9}

- Intradental Attachments: Contained within crown/ root structure of a natural tooth. It is a subdivided in 2 groups reflecting the type of retentive mechanism to hold the parts together.
 - Frictional: That includes designs like tapered and parallel wall boxes and tubes, adjustable metal plates, springs, studs, locks.
 - Magnetic.

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- Extradental
 - **Cantilever**
 - Rigid – eg: Stabilex or Conex attachments, Scott attachments.
 - Mobile.
 - Rotational – eg: Gerber hinge (Cendres and Metaux), Gaerny hinge (APM Sterngold), The Dalbo attachment.
 - Resilient types - eg: Dalbo ball & socket joint with spring, Crismani attachment (Cendres and Metaux).
 - **Bar** – eg: Ackermann bar, Dolder bar (oval cross section).

Mensor's classification: An attachment classification based on shape, design and primary area of utilization of attachment.¹⁰

Coronal	Radicular	Accessory
1. Intracoronal 2. Extracoronal	3. Telescope stud (pressure buttons) 4. Bar <ul style="list-style-type: none"> • Joints • Units 	5. Auxillary <ul style="list-style-type: none"> A. Screw units B. Pawl connectors C. Bolts D. Stabilizers/ balancers E. Interlocks F. Pin/screws G. Rests

The "**Spectrum of Function**", outlined identifies five classes of attachments based on their resilient function(s) or lack of them¹¹

Class I	Rigid	Sterngold type 7 attachment, G/L attachment, D2.7 attachment
Class II	Vertical	Hader vertical, Preciverteg, Cylindrical resilient Dallabona
Class III	Hinge	May's attachment, Miniature Dalbo attachment
Class IV	Combination	Combination e.g. Octolink attachment, Standard Dalbo attachment
Class V	Rotation (+ Vertical)	O-So male attachment, Micropin female

Rigid (non-resilient) attachments are the first class. The next four classes are all resilient, but each is distinctly different. Classes II through V provide increasing "kindness" (decreasing stresses) to abutments as a result of different combinations of resilient movement(s) allowed in different attachments.

Classification by Harold Prieskel:^{3, 4, 12}

1. Intracoronal attachments:

- A. Those whose retention is entirely frictional

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- 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.:
 - a. Chayes attachment (Fig 1).
 - b. Crismani attachments.
 - c. McCollum unit (Fig 2).
 - d. Ancra attachment.
 - e. T-Geschiebe 123 (Fig 3).



Fig. 1: Chayes (1906)



Fig. 2: McCollum unit

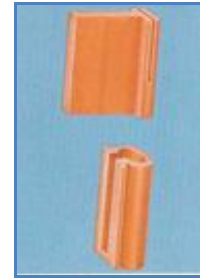


Fig. 3: T-Geschiebe 123

- 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.
 1. Round profiles are useful when anterior teeth are concerned.
 2. 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 4).



Fig. 4: Additional retention is provided by a spring loaded plunger

Depending on the cross sections intra coronal attachments can be classified into (fig 5)

1. H-Shaped flanges: The external frictional flange of H-Shaped unit strengthens the attachment, without increasing the size of the female part.

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2. T-shaped flanges: E.g. Chayes attachment.
3. Attachments with a circular cross section. They are suitable only for joining two sections of a fixed prosthesis.

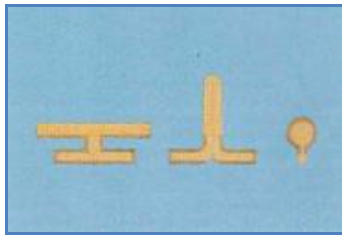


Fig. 5: showing attachments with H-shaped, T-shaped & circular cross sections of flanges

Attachments with auxiliary retentive features: Auxiliary retentive features are incorporated in some attachments in an effort to provide more retention for a given frictional area although no extra stability is provided. A minimum of 4 mm vertical space is necessary:

- Crismani units – incorporates a wire clip.
- Schatzmann series – a spring – loaded plunger within the male part, engaging a depression in the female element-rather like a simple cupboard door catch.
- Stern gingival latch attachment- the base of the male unit is split and formed in the shape of a door latch to provide a lock as the male slide is engaged.
- Micro attachment – smallest of intracoronal attachments with auxiliary retention.

Before choosing an attachment with auxiliary retentive devices the following factors should be considered.

- a. Bulk
- b. Adjustment
- c. Retention mechanism
- d. Trimming the attachment

2. Extracoronal attachments:

- a. Projection units: These units are attached to the proximal surface of a crown. E.g.: ASC -52.
 - Those that provide a rigid connection. e.g.: Conexattachment.
 - Those that allow play between the components. e.g.: Dalbo, Ceka 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 extracoronal hinge type unit connected to an intracoronal attachment. E.g.: Schatzmann attachment consisting of an intracoronal section with a projection.

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Fig. 7: Ceka extracoronal attachment



Fig. 8: The Dalbo extracoronal attachment

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 among the simplest of all attachments. They can provide additional retention, stability and support. Few stud attachments are entirely rigid because of their small size. Indeed springs and other devices have been incorporated in some designs in order to allow for some movement. Gerber, Dalbo, Zest, ERA, Prosnap, Profix all are stud attachments. Gerber is the largest stud unit¹³.



Fig. 9: Dalbo stud attachment

Types: Extra radicular stud attachments in which the male element projects from the root surface of preparation or implant. It forms a large and versatile group of retainers that have enjoyed success for many years. E.g. Microfix

Intra radicular stud attachments have similar characteristics to extra radicular units, although the retentive components work in a reverse manner in which male element forms part of the denture base and engage a receptacle in the root contour or implant. E.g. CekaRevax.

4. Bar attachments:

- a. Bar joints – allow play between the denture and the bar
 - Single sleeve bar joints e.g. Dolder bar joint, Baker clip (available in 12 or 14 gauge bar size)
 - Multiple sleeve joints: Hader, Ackermann, CM bar joints
- b. Rigid Bar units – with these attachments the sleeve\ bar junction is rigid.



Fig. 10: Dolder bar



Fig. 11: Ackermann

Applications:

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1. They act as relatively rigid connection between the implants to which they are attached by screws, which overcomes the divergence between the implants
2. Robust and effective retainers.
3. When employed to connect roots, the fact that the bar is close to the alveolar bone supporting the teeth results in far less leverage on the roots than if the occlusal rests had been employed.
4. Bar joints are applicable for over dentures constructions.
5. The design and construction of bar attachments can provide the denture with significant stability and retention.

5. Auxiliary attachments

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

DISCUSSION: A review of classification of attachments has been presented to explain the design characteristics of numerous attachments available. Broadly they may be classified as either precision or semi precision, depending on the method of fabrication and tolerance of fit. According to their relationship to the abutment tooth attachments are classified as extracoronal and intracoronal. Attachments are also classified as either rigid or resilient. The spectrum of function mentioned in the article will simplify the process of evaluating one resilient attachment over another.

It is critical that the appropriate attachment be utilized for each individual case situation. These classification systems aids in having a broader view about the type of attachment to be judiciously used since each clinical situation for which an attachment is intended will place specific demands that can be met, only if we have thorough idea about the diverse attachments available.

CONCLUSION: Attachments have been designed since the past century and more than 100 types are available.⁹ This article reviews different systems of classifying these devices to provide an overview of the designs available. In the spectrum of function, the higher the classification of the attachment, the greatest its resilient effect. It is proposed that this classification system will simplify and standardize descriptions of resilient attachments for (1) appropriate applications in prosthodontics therapy. (2) More relevant discussion in the dental literature. (3) Specific analysis in dental research. The greatest deterrent to the use of attachments is their complexity. Its use requires thorough knowledge of basic prosthodontics principles, appropriate training and experience with the particular attachment used, technical skills, clinical ability and judgment.

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