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Scientific Research University of
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Retention Means of Removable Partial Denture

A Project Submitted to
The College of Dentistry, University of Baghdad, Department of Prosthodontics in Partial Fulfillment for the Bachelor of Dental Surgery

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بسم الله الرحمن الرحيم

قَالُوا سُبْحَانَكَ لاَ عِلْمَ لَنَا
إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ
الْعَلِيمُ الْحَكِيمُ

صدق الله العظيم
سورة البقرة الآية (٣٢)

Certification of the Supervisor

I certify that this project entitled " Retention Means of Removable Partial Denture" was prepared by the fifth-year student Mohammed Anwer Adnan under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Dr. Ghazwan Adnan Al-Kinani.

Dedication

This project is wholeheartedly dedicated to my beloved father who have been my source of inspiration and gave me strength when l thought of giving up. To my beloved mother, without her love and prayers, I would never have been here. To my brother, sister, relatives and friends who shared their words of advice and encouragement to finish this study.

Mohammed Anwer Adnan

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First and lastly, all gratefulness, faithfulness and thankfulness to ALLAH for providing me with patience, perseverance and the ability to undertake and finally complete this study. I want to express my great thanks with respect to **“Dr. Raghad Abdul-Razaq Al-Hashimy”**, Dean of the Collage of Dentistry, University of Baghdad for his support to the research student’s program. I would like to thank **“Dr. Abdulbasit Ahmed Fatihallah”,** the head of Prosthodontics Department, for its scientific support, encouragement and advice. Also I would thank my supervisor “**Dr. Ghazwan Adnan Al-Kinani**”, for his continuous support.

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Introduction

The art or science of replacing absent body parts is termed prosthetics, and any artificial part is called a prosthesis. The term partial denture is used to describe many situations and several types of appliances. A removable partial denture (RPD) is for a partially edentulous dental patient who desires to have replacement teeth for functional or esthetic reasons, and who cannot have a bridge (a fixed partial denture) for any number of reasons, such as a lack of required teeth to serve as support for a bridge (i.e. distal abutments) or due to financial limitations. The reason why this type of prosthesis is referred to as a removable partial denture is because patients can remove and reinsert them when required without professional help. Conversely, a "fixed" prosthesis can and should be removed only by a dental professional **(Davis and Victor, 1973)**.

Besides being an immediate/temporary denture, the RPD also has many other applications, such as for partial edentulous individuals with an absence of alveolar bone, jaw, or soft tissue. In addition, an RPD can be used for occlusal reconstruction, as a removable periodontal splint, as an immediate surgical obturator (cleft of palate obturator), or as a food impaction appliance **(Jing and Xinzhi, 2014)**

There are three major objectives: The restoration of the functions of mastication and speech, the restoration of dental and facial aesthetics, and the preservation of the remaining teeth and their supportive tissues **(Jeffrey, 2022).** There is some important terminology that relate to RPD prosthesis

Support: The foundation area on which a dental prosthesis rests; with respect to dental prostheses, the resistance to forces directed toward the basal tissue or underlying structures.

Stability: The quality of a complete or removable partial denture to be firm, steady, or constant, to resist displacement by functional horizontal or rotational stresses.

Retention: That quality inherent in the dental prosthesis acting to resist the forces of dislodgment along the path of placement. (e. g., the force of gravity, the adhesiveness of foods, or the forces associated with the opening of the jaws) **(Robert, 2011).**

Aims of study

1. To review the type of mechanical means of retention to retain the removable partial denture and prevent the denture displacement.

2. To review better results to the patients regarding the retention of removal partial denture.

Chapter One

Review of literature

1.1 Definition of Retention

Retention is the ability of a removable partial denture (RPD) to resist dislodging forces during function. Retention of a removable prosthesis is a unique concern when compared with other prostheses. When one is dealing with a crown or fixed partial denture, the combined use of preparation geometry (i.e., resistance and retention form) and a luting agent can fix the prosthesis to the tooth in a manner that resists all forces to which the teeth are subjected **(Alan and David, 2016).** Retention depends upon several factors **(Robert, 2011).**

1. adhesion, cohesion, interfacial surface tension and atmospheric pressure
2. gravity
3. frictional retention (guiding planes, bracing elements)
4. indirect retention
5. direction of dislodging force relative to the path of placement.
6. mechanical retention

Retention of an RPD can be achieved by using mechanical means such as clasps which engage undercuts on the tooth surface, harnessing the patient's muscular control acting through the polished surface of the denture and using the inherent physical forces which arise from coverage of the mucosa by the denture **(Davenport *et al*., 2000).** Sufficient retention is provided by two means. Primary retention for removable partial denture is accomplished mechanically by placing retaining elements (direct retainers) on the abutment teeth. Secondary retention is provided by the intimate relationship of the minor connector contact with the guiding planes ,denture bases, and major connectors (maxillary) with the underlying tissue . secondary retention is similar to the retention of complete denture **(Alan and David, 2016).**

1.2 Mechanical means of retention classified according to retainer.

1.2.1 Direct retainer

Is any unit of a removable dental prosthesis that engages an abutment tooth to resist displacement of the prosthesis away from basal seat ttissue. It’s either clasp assemblies or attachments (fig1.1) applied to an abutment tooth to retain an RPD in position **(Louis, 1994).**

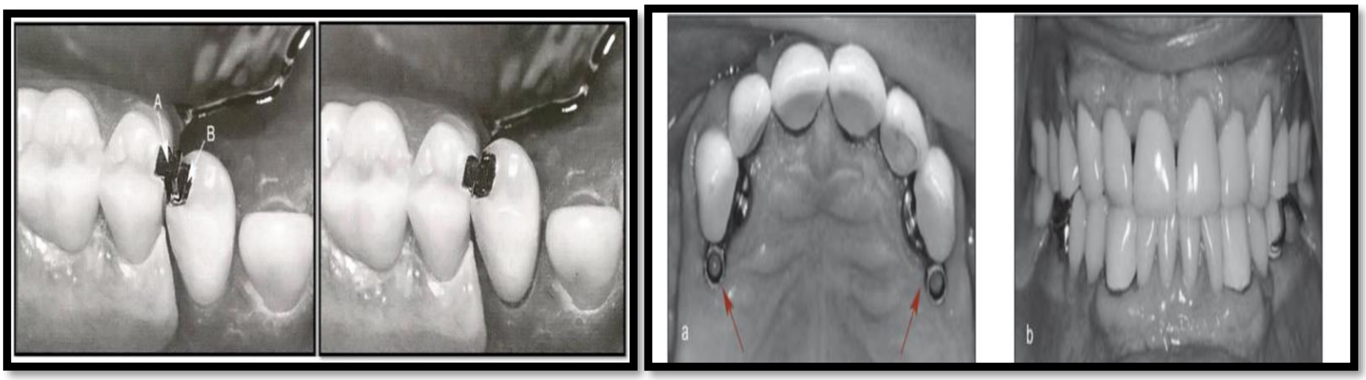


Fig. 1.1 Intracoronal retainer and the Extracoronal retainer **(Rodney *et al*., 2008).**

1.3 The Extracoronal (clasp-type) retainer

Is the most commonly used retainer for removable partial dentures. These retainer use mechanical resistance to displacement through components placed on or attached to the external surfaces of an abutment tooth **(Alan and David, 2016).**

Fig.1.2 Extracoronal (clasp-type) retainer **(Rodney *et al*., 2008).**

I. Retentive clasp assemblies

Clasps are used as direct retainers for the RPD. The flexible clasp tip engages the undercut of the abutment to provide retention. The components of any clasp assembly must satisfy six biomechanical requirements: retention, stability, support, reciprocation, encirclement and passivity **(Beaumont, 2002).**

1. Encirclement: The principle of encirclement means that more than 180 degrees in the greatest circumference of the tooth must be engaged by the clasp assembly as showing in (fig.3).

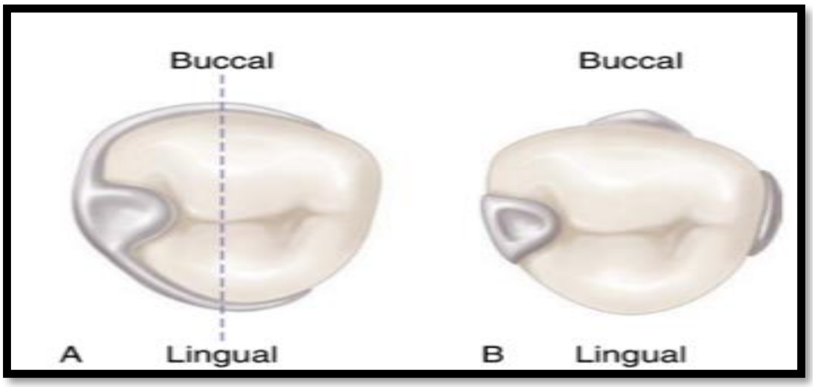


Fig.1.3 The engagement can be in the form of continuous contact, such as in a circumferential clasp (A), or discontinuous contact, such as in the use of a bar clasp (B) **(Alan and David, 2016).**

2. Support: The occlusal rest must be designed to prevent the movement of the clasp arms toward the cervical.
3. Reciprocation: Each retentive terminal should be opposed by a reciprocal component capable of resisting any transient pressures exerted by the retentive arm during placement and removal.
4. Clasp retainers on abutment teeth adjacent to distal extension bases should be designed so that they will prevent direct transmission of tipping and rotational forces to the abutment.
5. Retentive clasps should be bilaterally opposed, i.e., buccal retention on one side of the arch should be opposed by buccal retention on the other, or lingual on one side opposed by lingual on the other.
6. The amount of retention should always be the minimum necessary to resist reasonable dislodging forces.
7. Reciprocal elements of the clasp assembly should be located at the junction of the gingival and middle thirds of the crowns of abutment teeth. The terminal end of the retentive arm is optimally placed in the gingival third of the crown. These locations permit better resistance to horizontal and torqueing forces because of a reduction in the effort arm.
8. Passivity: When the clasp is in its place on the tooth surface, it should be at rest, the retentive tip of the clasp arm must be passive and remain in contact with the tooth ready to resist vertical dislodging force, so when a dislodging force is applied the clasp arm should immediately become active to engage tooth surface resist vertical displacement.

II. Components of clasp assembly (Jyotsna Rao, 2017).

1) Rest It is the part of the clasp that lies on the occlusal, lingual or incisal edge of a tooth and provides support for prosthesis, by resisting tissue ward movement of the clasp (clasp remains fixed).

2) Body It connects rest and clasp arms to minor connector.
3) Reciprocal arm it reciprocates/resists the tipping forces generated by the retentive clasp. Therefore, reciprocal clasp must be rigid and lie above the height of contour.
4) Retentive clasp arm it includes shoulder and retentive terminal.
5) Retentive terminal it is the distal third of the retentive clasp, which is positioned below height of contour for direct retention.
6) Minor connector It joins body of clasp assembly to the remainder of framework.
7) Approach arm it is a non rigid minor connector that joins body and retentive terminal of clasp to framework **(Olcay,2016).**

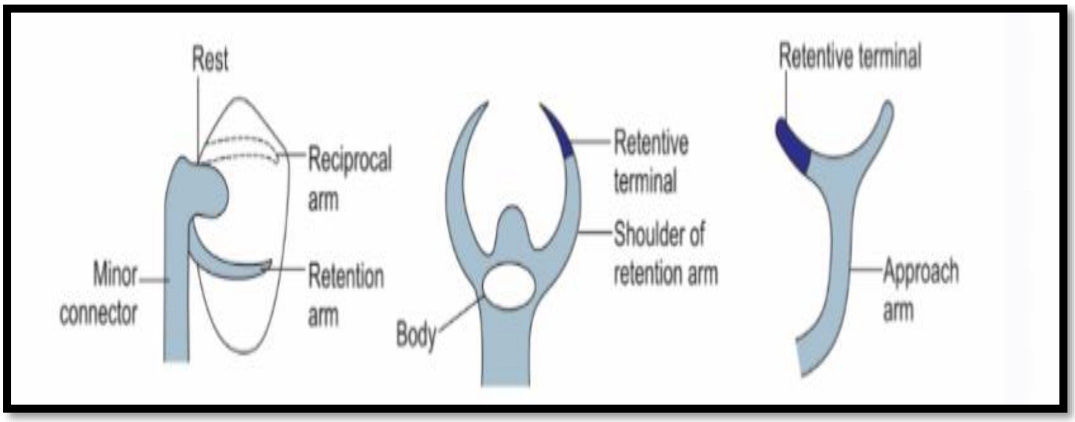


Fig.1.4 Component of clasp assembly **(Vijay Prakash, 2017).**

III. Factors Affecting the Amount of Retention of a Clasp Assembly

The amount of retention provided by a clasp assembly is based on the following factors: **(Alan and David, 2016).**

1. Angle of convergence cervical to the height of contour: Location of the retentive arm relative to the height of contour is very important for the retentive capabilities of the clasp assembly. The abutment tooth should have an angle of convergence cervical to the height of contour to be retentive. If the angle of convergence is not favorable for a particular path of placement under

consideration, a different path of placement should be provided, maintaining the suitable angle of convergence.

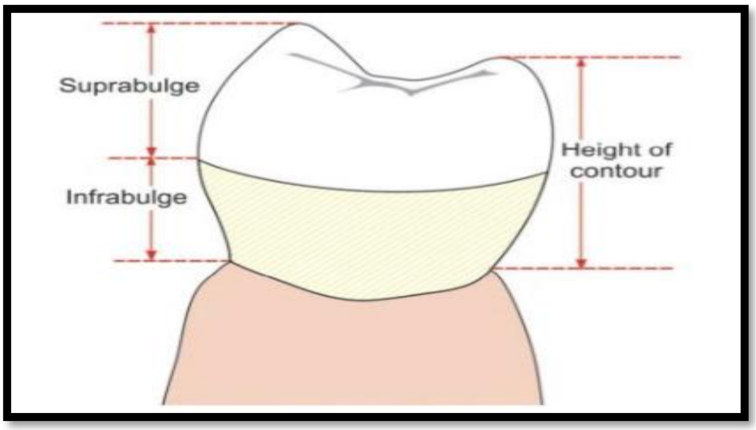


Fig.1.5 Principle of clasp retention **(Rangarajan, 2017).**

2. Flexibility of the clasp arm: The amount of retention depends on the flexibility of a clasp arm, and this is influenced by the following factors

A. Length: Increasing the length of the clasp arm increases the flexibility. Flexibility of the clasp is directly proportional to the cube of its length if all other factors are equal. Clasp length is measured from the point where the taper begins. Using tapered retentive arms instead of straight ones increases the length.

B. Diameter: Cube of the thickness of the clasp arm is inversely proportional to its flexibility if all other factors are equal. The retentive clasp arm should have a uniform taper from the beginning of the body to its tip. So the average diameter will be between its origin and its terminal end. If the taper is not uniform, a point of flexure and consequently a point of weakness will happen at the narrowed part of the clasp. Therefore, the uniform taper of the retentive clasp is essential. To accomplish the ultimate uniform taper for a clasp arm to be flexible, its cross-sectional shoulder dimension should be twice the terminus.

C. Cross-sectional form: Clasps with round forms are more flexible than clasps with half round forms. Round forms are flexible in any direction, whereas in half round forms, flexibility is limited to only one direction. But most cast clasps are half.

3.Clasp material: whereas all cast alloys used in partial denture construction possess flexibility; their flexibility is proportionate to their bulk. Greater rigidity with less bulk is possible through the use of chromium-cobalt alloys .Gold clasps are not as flexible or adjustable as wrought wire .Wrought wire clasp have greater tensile strength than cast clasps and hence can be used in smaller diameter to provide greater flexibility without fatigue fracture.

4. Relative uniformity of retention: having reviewed the factors inherent to a determination of the amount of retention from individual clasps, it is important to consider coordination of relative retention between various clasps in a single prosthesis.

5. Stabilizing-reciprocal cast clasp arm: when the direct retainer becomes active, the framework must be stabilized against horizontal movement. This stabilization is derived from either cross-arch framework contacts or a stabilizing or reciprocal clasp in the same clasp assembly.

IV. Classification of clasp assembly

In addition, the clasp assembly must ideally not affect aesthetics adversely The position of greatest convexity on the tooth, which is determined by surveying, serves as a guide in the placement of clasps. Clasps can be classified into infrabulge and suprabulge clasps **(McGivney *et al*., 2000; Donovan *et al*., 2001).** The suprabulge clasp approaches the undercut from an occlusal direction and is more visible. The infrabulge clasp, approaching the undercut from a gingival direction, also referred to as the gingivally approaching clasp, has more potential for being hidden in the distobuccal aspect of a tooth **(Davenport *et al*., 2000).** The infrabulge clasp has been thought to be more retentive than the suprabulge clasp because it possesses an inherent tripping action - although there is no evidence for this in the literature **(Donovan *et al*., 2001).** Shaping enamel surfaces and the use of composites can modify the convexity of a tooth surface and allow placement of clasps into a less visible position **(Hebel *et al*., 1984).** Clasps approaching the undercut from the distal aspect are less visible than mesially approaching clasps **(Applegate, 1965).**

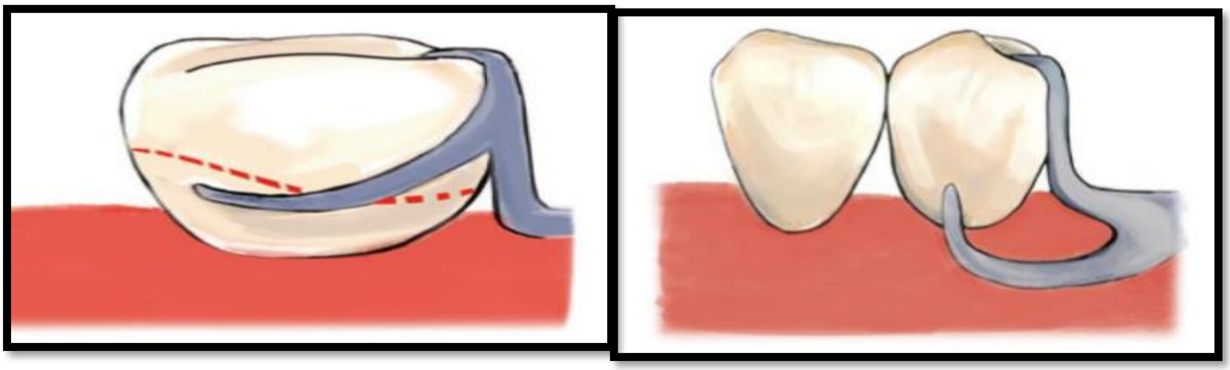


Fig.1.6 Suprabulge retentive arm arising from the occlusal surface of the abutment tooth and reaching the undercut area, Infrabulge retentive arm arising from the gingival surface of the abutment tooth and reaching the undercut area **(Olcay Şakar, 2015).**

V. Clasps for tooth-borne partial dentures (Class III, IV).

Have one function to prevent dislodgment of the prosthesis without damage to the abutment teeth. Since there is little or no rotation caused by tissue ward movement of the edentulous area (as happens in distal extension cases) stress releasing properties are usually not required. These clasps can also be used in modification spaces for tooth and tissue supported removable partial dentures (Class I, II) (**Alan and David, 2016).**

A. Circumferential (Circle or Akers) clasp

The most simple and versatile clasp (clasp of choice in tooth-borne cases). clasp assembly has one retentive arm opposed by a reciprocal arm (fig.7) originating from the rest the retentive arm begins above the height of contour, and curves and tapers to its terminal tip, in the gingival 1/3 of the tooth, well away from the gingiva the bracing arm is in the middle 1/3 of the tooth, and is broader occluso-gingivally, does not taper and is either entirely above the height of contour or completely on a prepared guiding plane. it should never be designed into an undercut, as it is a rigid element. Some of the advantages of this clasp is: excellent bracing qualities, easy to design and construct and less potential for food accumulation below the clasp compared to bar clasps. But most common drawbacks of this clasp are more tooth coverage and more metal displayed than bar clasp, and adjustments are difficult or impossible due to the half round nature of the clasp **(Robert and Loney, 2011).**

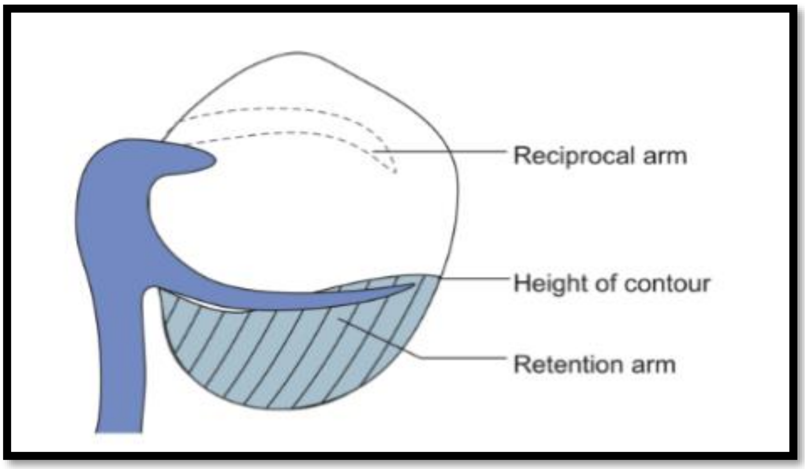


Fig.1.7 Design features of circumferential clasp **(Vijay and Ruchi, 2017).**

B. Ring Clasp

This type of clasp encircles nearly all the tooth surface from its point of origin see (fig.8) It is indicated on the tilted molars (maxillary molars tilt mesiobuccally and mandibular molars tilt mesiolingually). The ring clasp is used when the proximal undercut cannot be approached by other means. It engages the proximal undercut by encircling the entire tooth from point of origin.

Disadvantages of this clasp are: Large surface area of tooth is covered, difficult to adjust and repair and Contour of the crown is drastically altered **(Vijay and Ruchi, 2017).**

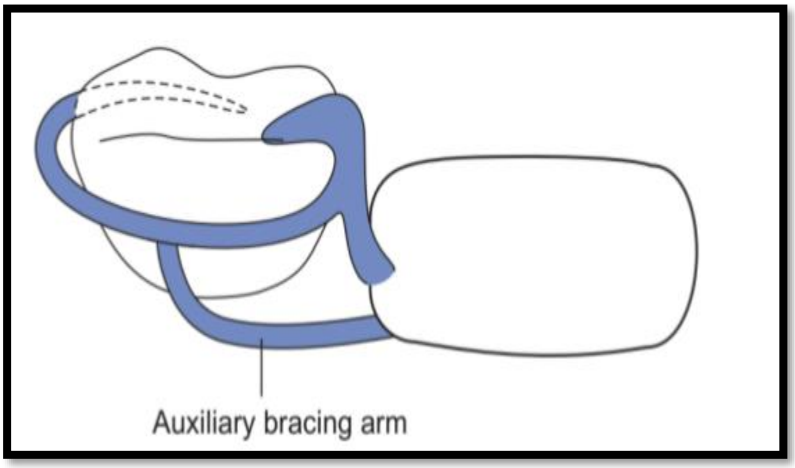


Fig.1.8 Ring clasp with auxiliary bracing arm for reinforcement **(Vijay and Ruchi, 2017).**

C. The Embrasure clasp

This clasp used where no edentulous space exists. It passes through the embrasure, using two occlusal rests, and clasps the two teeth with circumferential clasps **(Om Prakash, 2022).** Embrasure clasps should have two retentive clasp arms and two reciprocal clasp arms that are bilaterally or diagonally opposed. Some of drawbacks this type demonstrates a high percentage of fracture caused by inadequate tooth preparation in the contact area. Because vulnerable areas of the teeth are involved, abutment protection with inlays or crowns is recommended and Covers large area of tooth surface. Indicated In an unmodified Class II or Class III partial denture, where there are no edentulous spaces on the opposite side of the arch to aid in clasping **(Alan and David 2015).**

Fig.1.9 Occlusal and proximal surfaces of adjacent molar and premolar prepared for embrasure clasp. Note that rest seat preparations are extended both buccally and lingually to accommodate the retentive and reciprocal clasp arms **(Alan and David 2015).**

D. Multiple Circlet Clasp

It is a combination of two simple circlet clasps joined at the terminal end of the reciprocal arms. It is clasp of choice for broad stress distribution **(Saglik , 2009)** used to splinting weakened teeth. Its disadvantage is that two embrasure approaches are necessary rather than a single common embrasure for both clasps **(Deepak, 2017).**

E. Half and Half Clasp

It has a retentive arm arising from one direction and a reciprocal arm arising from another. Two minor connectors are needed for this design. The first minor connector attaches the occlusal rest and the retentive arm to the major connector. The second minor connector connects the reciprocal arm, which is similar to the bar clasp with or without an auxiliary rest. This design produces large tooth coverage, which can be reduced by converting the reciprocal arm into a short bar with an auxiliary occlusal rest **(Deepak, 2017).**

F. Fishhook or Hairpin Clasp or Reverse Action Clasp.

It is a type of simple circlet clasp, which after crossing the facial surface of the tooth loops back to engage the proximal undercut beneath its point of origin. Upper arm is rigid and the lower arm is flexible. The upper arm should be positioned above the height of contour in such a way that it does not interfere with occlusion. Indicated when the undercut is adjacent to edentulous area and Presence of a soft tissue undercut. Clasp arm is designed to permit engaging a proximal undercut (undercut adjacent to edentulous space) from an occlusal approach. It has poor aesthetics and ends to trap and accumulate rood debris **(Deepak, 2017).**

G. Back action clasp.

The back-action clasp is a modification of the ring clasp. It is used on premolar abutment anterior to edentulous space. The undercut can usually be approached just as well using a conventional circumferential clasp, with less tooth coverage and less display of metal **(Vijay and Ruchi, 2017).**

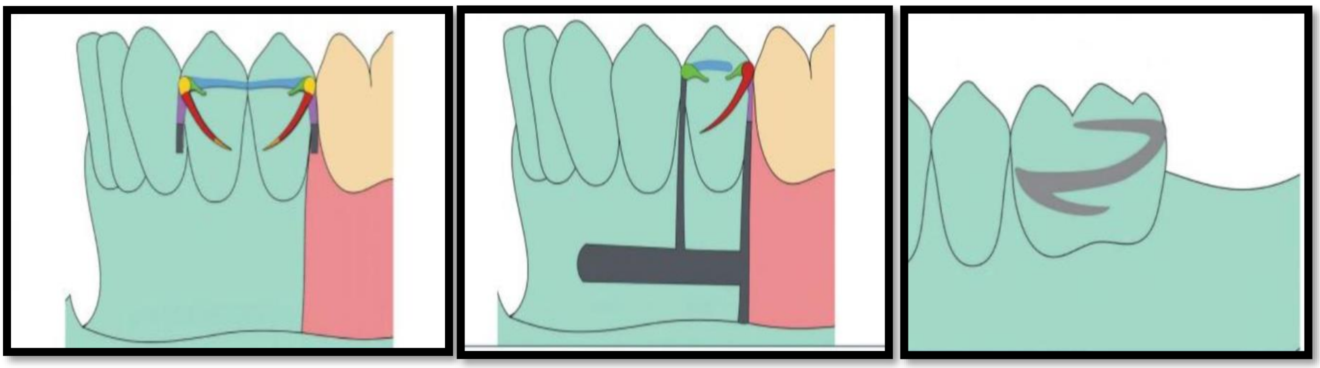


Fig.1.10 Multiple Circlet Clasp, Half and Half Clasp, Hairpin Clasp **(Deepak, 2017).**

VI. Clasps For Tooth and Tissue Borne RPD's.

Two strategies are adapted to either: Change the fulcrum location and subsequently the "resistance arm" engaging effect (mesial rest concept clasp assemblies). Minimize the effect of the lever by use of a flexible arm (wrought-wire retentive arm). These are proposed to accomplish movement accommodation by changing the fulcrum location to prevent harmful tipping or torqueing of the abutment tooth and prevent more denture base movement. This is concept include RPI and RPA clasps **(Alan and David 2015).**

A. RPI clasp.

Basically, this clasp assembly consists of: A mesioocclusal rest with the minor connector placed into the mesiolingual embrasure, but not contacting the adjacent tooth. A distal guiding plane, extending from the marginal ridge to the junction of the middle and gingival thirds of the abutment tooth, is prepared to receive a proximal plate. The buccolingual width of the guiding plane is determined by the proximal contour of the tooth. The proximal plate, in conjunction with the minor connector supporting the rest, provides the stabilizing and reciprocal aspects of the clasp assembly. I-bar should be located in the gingival third of the buccal or labial surface of the abutment in a 0.01-inch (0.25mm) undercut. The whole arm of the I-bar should be tapered to its terminus, with no more than 2 mm of its tip contacting the abutment. The retentive tip contacts the tooth from the undercut to the height of contour. This area of contact along with the rest and proximal plate contact provides stabilization through encirclement. The horizontal portion of the approach arm must be located at least 4 mm from the gingival margin and even farther if possible. The bar clasp arm arises from the denture framework or a metal base and approaches the retentive undercut from a gingival direction. The bar clasp arm has been classified by the shape of the retentive terminal. Thus it has been identified as T, Y, L, I, U and S.

I shape bar is prefer than other shapes because this shape being biologically and mechanically sound (**Alan and David, 2016).**

Fig.1.11 I Bar clasp **https://slideplayer.com/slide/5899215/.**

B. RPA clasp (Akers clasp).

This clasp assembly is similar to the RPI design except a wrought wire circumferential clasp (Akers) is used instead of the I-bar. This clasp arises from the proximal plate and terminates in the mesiobuccal undercut. It is used when there is insufficient vestibule depth or when a severe tissue undercut exists. This clasp minimize the effect of the lever by use of a flexible arm (wrought- wire retentive arm) (**Olcay, 2015)**

C. Combination clasp

Another strategy to reduce the effect of the Class I lever in distal extension situations is to use a flexible component in the "resistance arm," which is the strategy employed in the combination clasp. The combination clasp consists of the cast reciprocal arm and wrought retentive arm. is usually indicated in greater or a deeper undercut area where more flexibility of the retentive clasp arm is required **(Lakshmi, 2018).** Advantages of this clasp is **(Rangarajan and Padmanabhan, 2017).**

1. Good flexibility - helps dissipate stresses on abutment.
2. Easy to adjust the clasp as it can flex in all planes.
3. More aesthetically acceptable as it can be placed in gingival third of facial surface - can be used in pre- molars and canines.
4. Makes only a line contact with tooth surface and hence collects less food and is easy to maintain.

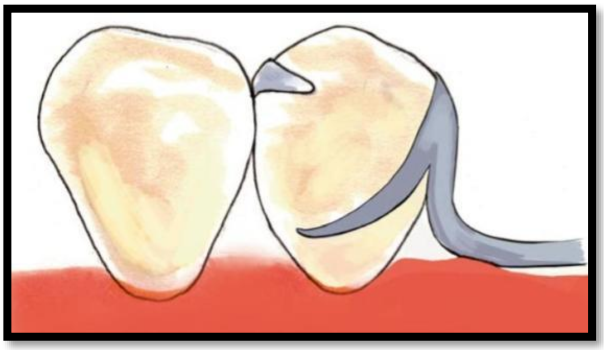


Fig.1.12 The RPA clasp assembly. A mesially placed occlusal rest, a distally placed proximal plate, and an Akers clasp (**Olcay, 2015).**

1.4 Attachments.

An attachment is defined as "A mechanical device for the fixation, retention, and stabilization of prosthesis". 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 or pontic as shown in (fig.13). This type of attachment provides stability and retention for removable distal extension prostheses **(Arti *et al*., 2018).** The advantages of attachment is excellent aesthetics, less stressful to the abutment teeth than the conventional clasp, easier to repair when necessary, less chances of caries, abrasion or erosion of the abutment teeth. They are easily adjusted to any amount or degree of tightness with no danger of strain on the abutment teeth and They are very easily kept clean because there are no exposed parts except the saddles and connectors. The disadvantages include the following: **(Sanjna, 2021).**

1. Extensive preparations of teeth are required.

2. The metal parts are subjective to wear as a result of friction, so the male portion fits more loosely thus permitting excessive movement and causing injury to the abutment teeth.

3. The extra-coronal type of attachment may cause gingival irritation.

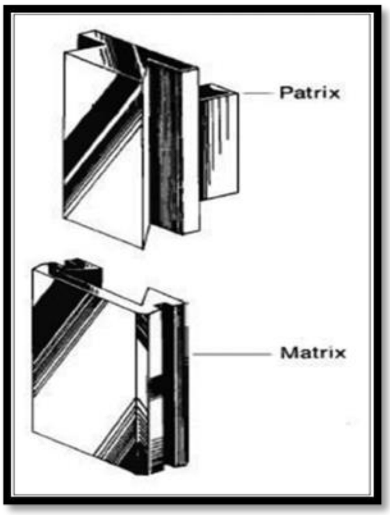
4. Sometimes extra-coronal type of attachments occupy the space where replacement teeth should be ideally positioned.

5. Less economical.

1.4.1 Type of attachments (Reeta and Swati, 2017).

- **A.** Precision attachment (prefabricated types) prefabricated machined components with precisely manufactured metal to metal parts with close tolerance.
- **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.
- **C.** Intracoronal / internal attachment:- If the attachment resides within the body / normal contours of the abutment teeth. They are used to connect units of fixed partial prostheses, retaining restorations with distal extension or bounded removable prostheses **(Hema *et al*., 2018).**

D. Extracoronal / external attachment:- If the attachment resides outside the normal clinical contours of the abutment crown / teeth **(Becerra and Macentee, 1987; Merrill and Mensor, 1973).**



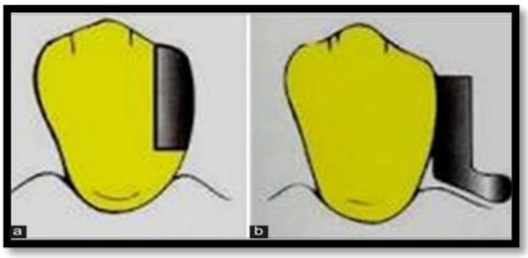


Fig.1.13 Components of attachments. **Fig.1.14** Types of attachments according to the relationship to the abutment teeth. (a) Intracoronal attachment. (b) Extracoronal attachments **(Arti *et al.*, 2018).**

External attachment Consisting of 3 units: **(Khuthija *et al*., 2014)**

1. Projection units: These units are attached to the proximal surface of a crown.
    - ➢ Those that provide a rigid connection. e.g.:Conex attachment.
    - ➢ Those that allow play between the components. e.g.:Dalbo, Ceka attachment.
2. 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.

3. Combined units: This attachment consists of an extracoronally placed hinge type unit connected to an intracoronal attachment. E.g.: consisting of an intracoronal section with a projection.

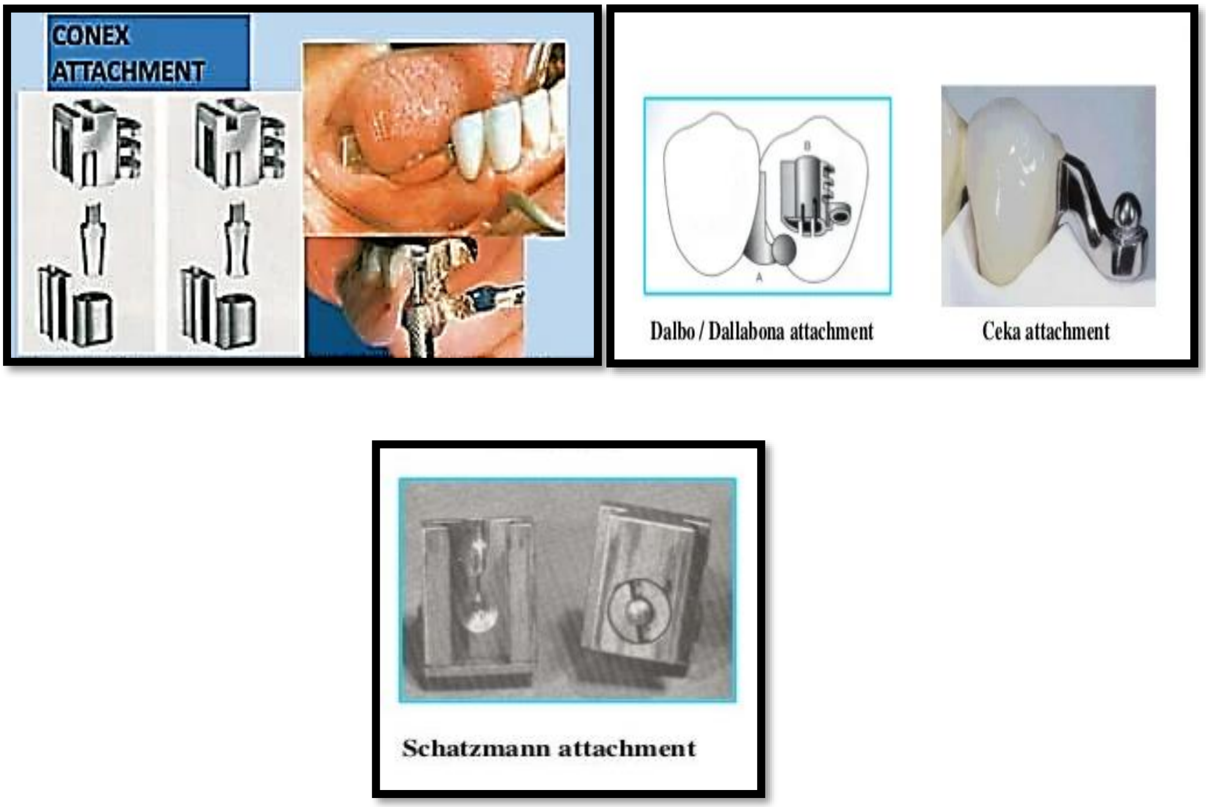


Fig.1.15 Units of External attachment **(Jain, 2017).**

E. Stud attachments: They are in the form of ball & socket and this attachment serves primarily for over denture stabilization and retention of the prosthesis. Zest anchor attachment and locator is example of stud attachment **(Hema *et al.*, 2018**). Locator attachments can be a suitable alternative to ball attachments because of their low profile, when the inter-arch distance or the height of the denture is inadequate for placing ball attachment. Locator Attachment characterized by having different abutment heights (0 to 6mm depending on the implant system) to allow for various soft tissue thicknesses, and also by having a low profile design, which means that the abutment does not protrude significantly above the marginal tissue height and also the male connector occupies less space within the denture **(Alsiyabi *et al*., 2005; Lee and Agar, 2006).**

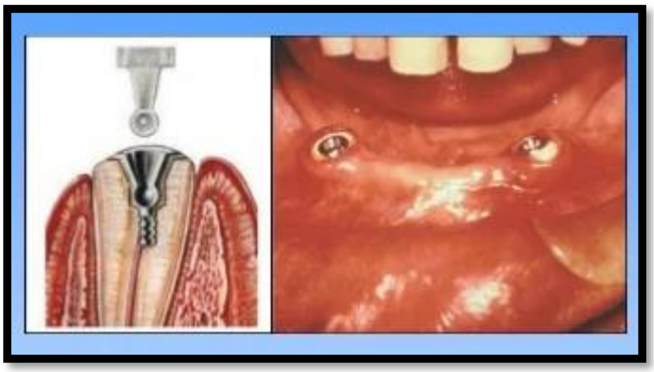


Fig.1.16 Zest anchor attachment (**Nigam, 2014).**

Fig.1.17 Partially edentulous maxilla after placement of four implants in areas of adequate bone volume and subsequent placement of Locator implant attachments. Tissue surface of claspless implant-retained RPD with Locator housings and retentive inserts in place **(https://www.aegisdentalnetwork.com/media/12698/)**

F. Bar attachments used for splinting groups of teeth and for overdenture retention and stabilization (Fig.18). They consist of a precision attachment bar and channel clips. Examples are Dolder, and Hader bar. The main disadvantage of bar attachments is that they cannot be used with reduced interocclusal space **(Nigam, 2014).** Hader Bar can serve either as a bar joint or a bar unit or as stud. It consist of preformed plastic bars and clip. The plastic bar is attached to the coping wax-up and is casted with the coping. The plastic clips can be imbedded in the denture base to gain retention **(Krishankumar *et al*., 2020).**

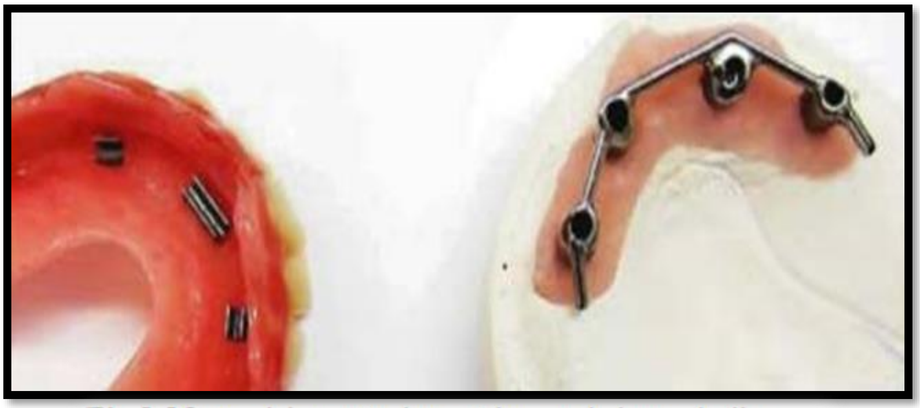


Fig.1.18 precision attachment bar and channel clips (Krishankumar *et al.*, 2020).

1.5 Indirect Retainers

Partial denture movement can exist in three planes; horizontal, frontal, and sagittal. Tooth-supported partial dentures use teeth to control movement away from the tissues. Tooth-tissue-supported partial dentures have at least one end of the prosthesis free to move away from the tissue. This may occur because of the effects of gravity in the maxillary arch or adhesive foods in either arch. Thus, there is an axis or line about which the denture will rotate when the bases move away from the residual ridge and this is associated with tooth-tissue supported partial dentures. A fulcrum line is a theoretical line around which a removable dental prosthesis tends to rotate when subjected to forces towards or away from the residual ridge. Thus, an indirect retainer is the component of a removable partial denture that assists the direct retainer (s) in preventing displacement of the distal extension denture base by functioning through lever action on the opposite side of the fulcrum line when the denture base moves away from the tissues in pure rotation around the fulcrum line. Therefore, the main function of the indirect retainer is to prevent movement of a distal extension base away from the tissues **(Alan and David, 2015).** An indirect retainer consists of one or more rests and the supporting minor connectors and should be placed as far from the distal extension base as possible in a prepared rest seat on a tooth capable of supporting its function. The proximal plates, adjacent to the edentulous areas, also provide indirect retention. although it is customary to identify the entire assembly as the indirect retainer, it should be remembered that the rest is actually the indirect retainer united to the major connector by a minor connector. The most effective location of an indirect retainer is in the area of an incisor tooth as shown in (fig.19),but this tooth may not be strong enough may have steep inclines that cannot support a rest. Thus, the nearest canine or the mesioocclusal surface of the first premolar may be the best location for the indirect retention and on both sides of the arch closer to the fulcrum line are used to compensate for the compromise in distance. When an indirect retention is included in distal extension dentures, (1) forces acting to dislodge the distal extension bases are neutralized. Also, (2) the rotational axis shifts from the abutment teeth to the indirect retainers and as long as the clasp assemblies resist the vertical dislodging forces, the prosthesis remains in place **(Rodney *et al*., 2008).**

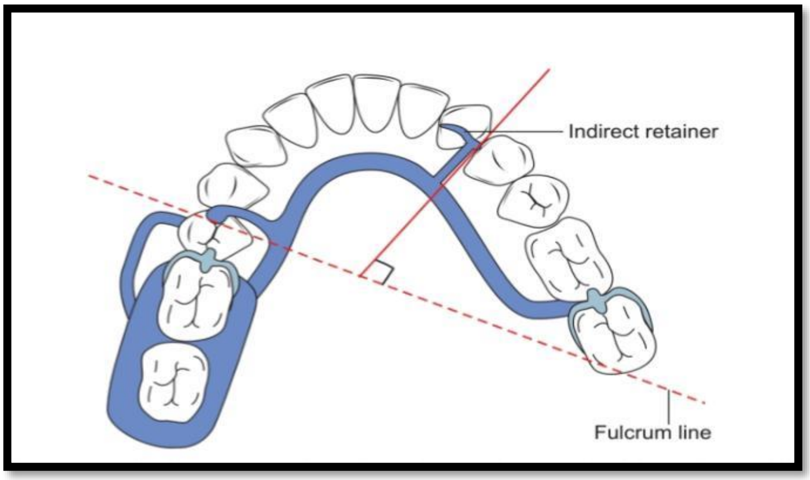


Fig.1.19 showing the position of indirect retainer
(Vijay and Ruchi, 2017).

1.5.1 Factor influencing the effectiveness of indirect retainers (Lakshmi, 2022).

1. The principal occlusal rests on the primary abutment teeth must be reasonably held in their seats by the retentive arms of the direct retainers

2. Distance from the fulcrum line. The following three areas must be considered:

a. Length of the distal extension base

b. Location of the fulcrum line

C. How far beyond the fulcrum line the indirect retainer is placed

3. Connectors supporting the indirect retainers should be rigid

4. Tooth inclines and weak teeth should never be used to support indirect retainers

1.5.2 Types of Indirect Retainers (Rangarajan and Padmanabhan, 2017).

A. Occlusal rest: This is most commonly used. Definite occlusal rest seat should be prepared on the occlusal surface so that the forces are transmitted along the long axis of the tooth. It is most commonly placed on the mesial marginal ridge of the first premolar in Kennedy's class I situation. In class II situation, it is commonly placed on the first premolar on the opposite side.

B. Canine rest: Given in case the first premolar is closer to the fulcrum line. It is placed on the cingulum of the canine. Canine rest is always preferred to the incisal rest because of its mechanical advantages. This type of rest becomes more effective, if the minor connector is placed in the embrasure space anterior to the canine and arcs backward into the lingual rest seat.

C. Canine extension from the occlusal rest: A finger extension from a premolar occlusal rest is placed on the lingual slope of the canine.

D. Lingual plate: When the lingual plate is supported with the rests on both the ends, it provides effective retainer. This extension helps in providing indirect retention. This type of extension is used in cases where the first premolar serves as the primary abutment.

E. Modification area: In cases of class II modification I, the secondary abutment can serve as an indirect retainer.

F. The rugae area of the maxillary arch, if covered in the partial denture, can serve as effective indirect retainer as in horseshoe design where posterior retention is not sufficient. Tissue support provided by the rugae region is less effective than the tooth-supported

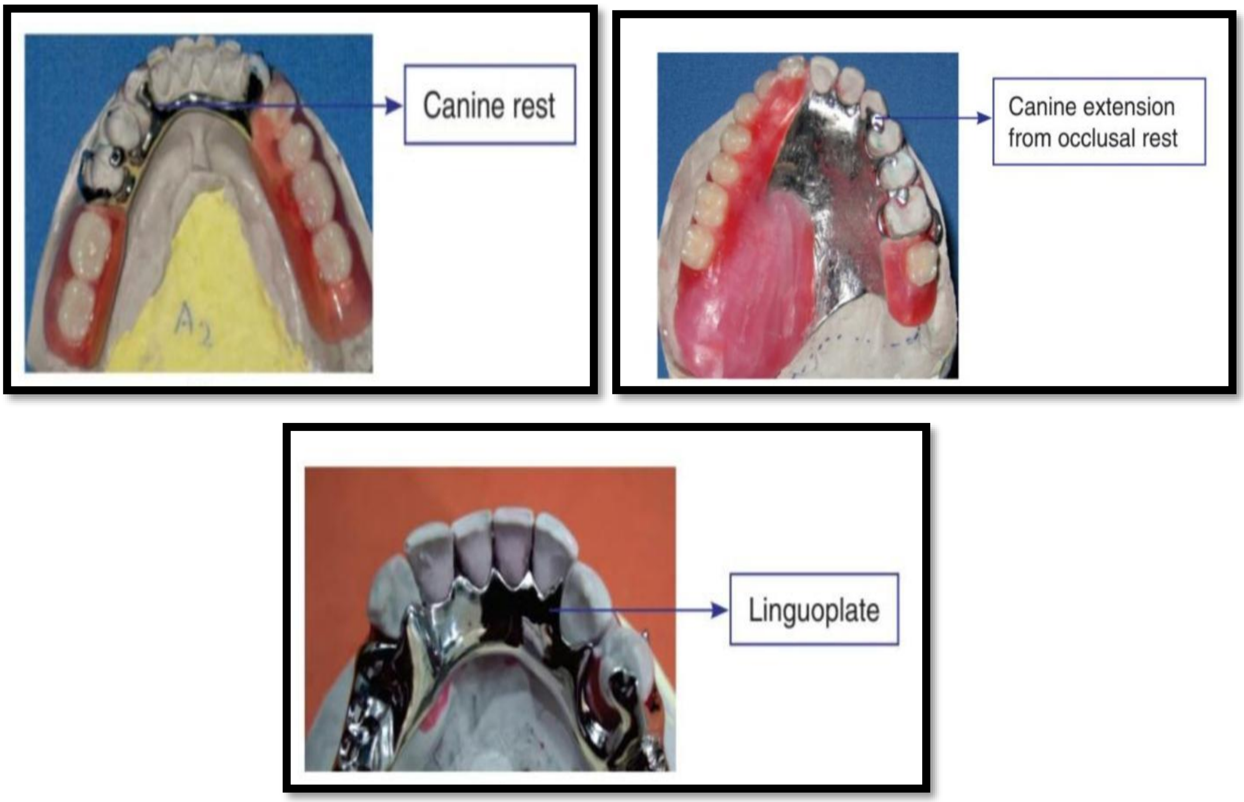


Fig.1.20 Types of Indirect Retainers **(Lakshmi, 2022).**

Chapter two

Conclusions

- Removable partial dentures are a conservative and economical treatment option to replace missing teeth in partially edentulous patients, improving their quality of life. However, its conventional fabrication is a complex and time-consuming process. To satisfy the patients aesthetically and functionally, new materials and new techniques of dentures manufacturing are developed.

- Partial dentures can provide satisfactory outcomes for patients if they are designed to provide optimum support, stability and retention.

- The removable partial denture not only aims towards the restoration of esthetics and phonetics but should also have special emphasis on function during fabrication.

- Several mechanical means were discussed in this review for providing removable partial denture with high retention. The mechanical retentive option depends on the case so no option has superiority on the other.

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