Review Article

Components of removable appliance in orthodontics

S. S. Priyadharshni, K. Saravana Pandian

ABSTRACT

Aim: The aim of this article is to review the retentive components in the removable appliance. **Objective:** The objective of this study is to review the advantages, clinical significance of retentive components in the removable appliance. **Background:** Retentive components help to retain the appliance in place and resist displacement due to various factors. The effectiveness of the active components is dependent on the retention of the appliance. Good fixation will help patient compliance, anchorage, and tooth movement. **Conclusion:** One of the most important factors for wearing an appliance is its retention. This is fulfilled with the parts so-called clasps. Clasps should be designed in a way that functions properly and efficiently. Bulky clasps can diminish the desire of wearing the gadget by youngsters, resulting in frustration of patient and disruption of the process of treatment, as well.

KEY WORDS: Anchorage, Clasps, Removable appliance, Retentive components, Tooth movement

INTRODUCTION

Removable appliances take a considerable share in contemporary orthodontic treatments. The appliance was the innovation of George Crozat, in the early1900s. It was later more developed in European countries but had fewer roles in the mainstream of the United States orthodontics. Instead, American orthodontists tended to use almost exclusively fix appliances. In fact, Europeans pioneered the "functional" application of removable appliances for growth modification, at large.[1] These appliances would resolve minor to mild dental problems or can reduce the length of fix treatment, at least. However, the key success of treatment is the patient compliance with the appliance.[2] The looseness and soft tissue irritation of the gadget would definitely reduce the success rate of treatment. One of the most important factors for wearing an appliance is its retention. This is fulfilled with the parts so-called clasps. Clasps and springs should be designed in a way that functions properly and efficiently. Bulky clasps can diminish the desire of wearing the gadget by youngsters, resulting in frustration of patient and disruption of the process of treatment, as well.

It is the appliance that is fabricated mainly from acrylic and stainless steel wire, it's action confined to a single arch to move teeth, and can be removed from the mouth by the patient. The functional appliances of the same materials but differ in their work as they are exerting intermaxillary forces. Most removable appliances are made for the upper arch because patients generally poorly tolerate the lower appliance. This is due in part to their encroachment on tongue space; furthermore, the appliance retention is compromised by lingual tilting of lower molars makes retentive clasping difficult in addition to the action of the tongue and lips which tending to unseat the appliance.

It should be kept in mind that all removable appliances of any kind are only capable of "tooth tipping" meaning that after repositioning the long axis of the tooth should become ideal in angulation and torque. Thus, a selected case for removable appliance requires the long axis of the tooth be so malpositioned that after movement the tooth can be located in the proper crown-root torque.[3] This biomechanics concept dictates the orthodontist to be very accurate in case selection. Thus, the removable technique is not considered as an alternative method if a patient needs comprehensive orthodontic care. Technically, appliance design has a key role in success. The location and type of clasps (for better retention and no tissue irritation), the location of finger springs (for maximum range of activation) and their direction (for the highest rate of activation) are important considerations in the design of an appliance.

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Department of Orthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, 162, Poonamallee High Road, Chennai - 600077, Tamil Nadu, India

***Corresponding author:** K. Saravana Pandian, Department of Orthodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India. E-mail: sporthoresearch@gmail.com

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RETENTIVE COMPONENTS

Scientifically, some clasps which are routinely included in all appliances do not have any designated purpose. It should be really reevaluated whether an Adams clasp with its tough adjustment, which provides only a little retention and creates serious occlusal interference, causing patient's discomfort, should be preferred over a "C" clasp. The design of the "C" clasp creates a contact surface with the anchor tooth rather than a two-point contact (Adams clasp), resulting in better retention. In addition, it offers the advantages of causing less tissue irritation along with easier adjustability and fabrication. Finally, a small and easy to adjust ball clasp in many cases can play a significant role in the retention of the appliance. The other consideration is the type of active part used in the appliance.[4]

C' Clasp

It is also known as three-quarter clasp (3/4 clasp) or circumferential clasp. They are very simple clasp and engage buccocervical undercut.

- Advantages: Easy to construct, simple design, prevent mesial migration of tooth
- Disadvantage: It cannot be used in partially erupted teeth.

Jackson's Clasp

It is also known as Full clasp or "U" clasp. It was introduced by V H Jackson in 1906. This clasp makes use of buccocervical undercut and also the mesial and distal proximal undercuts.

- Advantages: Simple to construct, offers adequate retention
- Disadvantage: Inadequate retention in partially erupted teeth.[4]

Arrowhead Clasp

This clasp was introduced by A M Schwarz in 1956. This clasp makes use of mesial and distal undercuts. This clasp is made using half round or round stainless steel wire of 0.7 mm diameter. This clasp is made by use of a special plier called "Tischler's plier."

- Advantages: Good retention on the partially erupted tooth, eruption of the tooth is not hampered
- Disadvantages: Occupies a large amount of buccal surface, requires special plier and adequate skill for construction. Continuous arrowhead clasp.

Adam's Clasp

It is also known as a universal clasp or modified arrowhead clasp or Liverpool clasp. This clasp was devised by C P Adam in 1948. This clasp makes use of mesial and distal undercuts. This is the most effective and most widely used orthodontic clasp today. This clasp is constructed using 0.7 mm hard round stainless steel wire.

Advantages: This clasp is strong, simple, and easily constructed, it can be used on any tooth (deciduous or permanent, partially or fully erupted, incisors, or premolars or molars), it is comfortable to wear and resistant to breakage, it is small and occupies minimum space, it can be modified in a number of ways, no specialized instrument is needed for construction of clasp. Routinely used Young's Universal plier or Adam's plier can be used.

Parts of Adam's clasp - two arrowheads, bridge. Two retentive arms bridge - it should be straight and midway between the occlusal surface and gingival margin. It should be 2 mm away from the tooth surface and parallel to it. When viewed from the side, the bridge should be at 45° angle to the tooth surface. Arrowheads - should be parallel to each other and should sit in the mesial and distal undercuts. Retentive arms - continue on the lingual or palatal surface that gets embedded into the acrylic.
Modifications of Adam's clasp:

- Adam's clasp with single arrowhead
- Adam's clasp with J hook
- Adam's clasp with incorporated helix
- Adam's clasp with additional arrowhead
- Adam's clasp with soldered buccal tube
- Adam's clasp with distal extension
- Adam's clasp on incisors and premolars.

Adam's Clasp with Single Arrowhead

This clasp consists of only single arrowhead instead of two arrowheads. This clasp combines characteristics of Adam's clasp and "C" clasp. It is indicated in the partially erupted tooth where the single arrowhead engages the mesial undercut and the bridge is modified to encircle the tooth distally. The partially erupted tooth is usually the last erupted molar.

Adam's Clasp with J Hook

A "J" shaped hook is soldered to the bridge of Adam's clasp directed gingivally with the hook pointed distally. This hook is used to engage elastics.

Adam's Clasp with Incorporated Helix

A helix is incorporated into the bridge of Adam's clasp. This is also useful in engaging elastics. This modification is preferred on mandibular molars.

Adam's Clasp with Additional Arrowhead

An additional arrowhead is soldered onto the bridge of Adam's clasp. This clasp is used when additional retention is required. The additional arrowhead fits the undercut of the adjacent tooth.

Adam's Clasp with Soldered Buccal Tube

Attachment of buccal tube to Adam's clasp was described by J C Stephenson. A buccal tube is soldered onto the bridge of Adam's clasp. This modification is used when an extraoral anchorage is needed using headgear or other assembly.

Adam's Clasp with Distal Extension

A small extension is incorporated distally in the distal arrowhead. This distal extension helps to engage elastics.

Adam's Clasp on Incisors and Premolars

This clasp is fabricated on incisors and premolars when retention is required in those areas. This clasp can be constructed in such a way that it can span a single tooth or two teeth.

Smart Clasp

A modified Adam's clasp this clasp was developed for use with magnetic activator device. The upper and lower plates, with incorporated magnets, of the appliance, exert attracting or repelling force of about 600 gm. A 2 mm loop on each side of the arrowhead is given in Adam's clasp.

Delta Clasp

This clasp was designed by William J. Clark. This clasp is similar to Adam's clasp in principle. It engages interdental undercuts: Adjustment: Hold retentive loop and twist inwards– and bending toward interdental undercut as it emerges from acrylic.

Southend Clasp

This clasp was named as south end clasp because it was developed by Mr. DiBiase and Mr. Leavis of the department of orthodontics, Southend hospital and was used at Bristol Hospital. It provides retention in the anterior region. The wire is adapted along the cervical margin of both the central incisors. The distal end of the wire crosses over the occlusal embrasures and end as retentive arms on the palatal side.

Advantages: Better patient compliance, Suitable for rotated and spaced incisors.

Triangular Clasp

It has a small triangular shape that engages the proximal undercut of two adjacent teeth. It provides excellent retention. It does not cause irritation of gingiva. It is used when additional retention is required.

Ball End Clasp

This clasp is also known as Scheu anchor clasp. This clasp has a ball at the end which engages the proximal undercut between two adjacent teeth (interdental area). Preformed wires having a ball at the end are used for making this clasp. The ball can also be made using silver solder. This clasp is used whenever additional retention is required.

Double Ball End Clasp

This clasp includes a stem embedded into and extending from the acrylic portion of the appliance. Two ball clasps extend from the stem and are laterally spaced apart from one another. Each ball clasp has an elongated flexible member and an enlarged exposed end. A bridge segment extends laterally between the flexible members of the first and second ball clasps. This clasp does not exert any wedging force in the interdental embrasure like the single ball clasp. This clasp provides better retention.

Schwarz Clasp

It is said to be predecessor of Adam's clasp. This clasp has a number of arrowheads that engage the inter-proximal undercuts of posterior teeth.

This clasp is not routinely used because it needs special arrowhead forming pliers, occupies a large amount of space in the buccal vestibule. The arrowheads can injure the interdental soft tissues. It is difficult and time-consuming to fabricate.

Crozat Clasp

This clasp was suggested by Crozat in 1920. It is a modification of Jackson's clasp. An additional piece of wire is soldered to the Jackson's clasp which engages into the mesial and distal proximal undercuts. Thus, it provides better retention than the Full clasp.

Duyzing Clasp

This clasp has two wires emerging from the plate that cross the occlusion over the anterior and posterior contact point of the tooth clasped. Each wire then goes above the greatest circumference of the tooth to the middle of the tooth and again back below using undercuts. This clasp is used to engage the buccal undercuts of molars. If the situation demands, only half of the clasp can also be made.

Eyelet Clasp

This clasp can be constructed as a single eyelet or continuous eyelet clasp.[5] An eyelet is made using a young loop forming plier. Eyelets are placed in the embrasure. Three to four eyelets can be made depending on the retention requirement. The size of the eyelet depends on the width of the interdental area of both anchor teeth.

Plint Clasp

Plint clasp is also known as "Fly Over Clasp." Plint clasp is useful when using a removable appliance in combination with a fixed appliance. These clasps are constructed using 0.7 mm stainless steel wire.[6] This clasp is used to engage under the tube assembly on a molar band. It is adjusted by moving the clasp under the molar tube.

Visick Clasp

This clasp was given by Visick. This clasp is used on the palatal side for active retention accompanying the base plate and molar clasp on buccal side. It is made using 0.7 mm stainless steel wire.[7] Retention is increased with this clasp because both the buccal and palatal surfaces are engaged.

ACTIVE COMPONENTS

They are the components of the appliance that exert forces to bring about the necessary tooth movement. They include Bows, Springs, Screws, and Elastics.

BOWS: Bows are active components that are mostly used for incisor retraction.

Short Labial Bow

- They are used only in case of minor overjet reduction.
- Anterior space closure.
- It can also be used for purpose of retention at the termination of fixed orthodontic therapy.

Long Labial Bow

- Minor anterior space closure.
- Minor overjet reduction.
- Closure of space distal to canine.
- Guidance of canine during canine retraction.
- Also is used for retention.

Split Labial Bow

- Anterior retraction
- Correction of midline diastema.

Labial Bow with Reverse Loops

- For minor retraction of incisors.
- For minor crowding.
- As retention.
- It is designed same as other Kabila bows except loops are reversed.
- Distal end goes up to the interdental area between the two premolars.
- Crossover wires go between canine and premolar.

Fitted Labial Bow

- Wire used: 0.7 mm or 21 gauge.
- Used as retention appliance after orthodontic treatment.
- Bow is adapted to the contours of the labial surface of the individual teeth.
- Bow is placed in the middle third and appliance should be passive.

Begs Labial Bow

- Also known as Beggs wrap-around retainer/around the globe bow.
- Popularized by P.R. Begg.
- It is used as retainer after fixed orthodontic therapy.

Roberts Retractor

- Designed by G.H. Roberts.
- Used for retraction of four incisors.
- Highly flexible so used in cases where >4 mm overjet is present.
- Excellent retraction bow.
- Horizontal bow component is the same as that of other labial bows but ending at the distal part of the lateral incisors.
- Coils are placed mesial to canine.

Activation:

- The bow is adjusted by bending the vertical limb below the coil.
- As the incisor moves palatally, the bow will drop anteriorly, and the level of horizontal part should be adjusted.

Mills Retractor

- Also known as extended labial bow.
- Extensive looping increases the flexibility.
- Highly flexible and so used for reduction of large overjets.
- Used for alignment of irregular incisors.

Disadvantage: Less comfortable to the patient. Difficult to fabricate.

Activation: Activated by compressing the extended loop and bending the bow palatally. Care should be taken to avoid trauma to the mucosa during treatment.

High Labial Bow with Apron Springs

- Consists of two components. (a) Heavy base archwire.
- Wire used: 0.9 mm or 19 gauge hard stainless steel wire.
- Design: High labial archwire with vertical arms incorporated and relived in the areas of labial frenum provides the base arch.
- High labial arch should not contact the mucosa and should not extend deep into the full depth of the sulcus.

Apron Springs

- They are the active component.
- Are attached to the base arch by winding a few turns in horizontal arms and then two of three turns in the vertical arm.
- Apron springs are bent into shape according to the number of teeth to be moved lingually.

SPRINGS

Spring is an active component of removable orthodontic appliances which brings about the desired tooth movement.

The types of springs which can be used to bring about the orthodontic tooth movement are:
a) Finger spring.
b) Single cantilever spring.
c) Double cantilever spring.
d) "T" spring.
e) Self supporting buccal spring.
f) Flapper spring.
g) Apron spring.
h) Coffin spring.
i) Reverse loop canine retractor.
j) Buccal canine retractor.
k) Palatal canine retractor.
l) "U" Loop canine retractor.

SCREWS

Screws are active components that can be incorporated in removable appliances. Screws can be used to bring about many types of tooth movement. The screws are activated by the patient at regular intervals using a key that is supplied for this purpose. Thus, appliances incorporating screws are a valuable aid in patients who cannot visit the dentist frequently for reactivation of the appliance.

Removable appliances having screws usually consist of a split acrylic plate and Adams clasps on the posterior teeth. The screw is placed connecting the split acrylic plate. These appliances can bring about various types of tooth movements based on the location of the split, the location of the screw and number of screws used in the appliance.

The removable appliances that make use of screws can bring about three type of tooth movements:
a) Expansion of arch
b) Movement of one or a group of teeth in a buccal or labial direction
c) Movement of one or more teeth in a distal or medial direction.[8]

ELASTICS

Elastics as active components are seldom used along removable appliances. They are mostly used in conjunction with fixed appliances. Removable appliances using elastics for anterior retraction generally make use of a labial bow with hooks placed distal to the canines. Latex elastics are stretched between them and lie over the incisors. The disadvantages of such an appliance include the risk of the elastic slipping gingival and causing gingival trauma and the risk of the arch from getting flattened.[9]

BASE PLATE

The bulk of the removable appliance is made of the acrylic base plate. Heat-curing autopolymerizing (self-cure or cold-cure), thermoplastic, and light-curing acrylic resin are the most commonly used orthodontic baseplate materials. The prime function of the base plate is to incorporate all the components together into a single functional unit. The base plate also helps in retention of the appliance and for anchorage.

In a study done by Matheus Melo, when palate relief was performed on the plates, there was a significant reduction in their resistance (80%). However, this resistance was enhanced by about 40% when the orthodontic wire was inserted into the acrylic.

Another study,[10] in which acrylic resin fatigue resistance in removable partial dentures was tested, found that when reinforced with berglass, these obtain superior resistance to those reinforced with metal. It suggests that the addition of other materials to the resins used in orthodontics may be an alternative to achieve greater durability for the apparatus. A similar result was found in this study, given that when the internal orthodontic wire was added it greatly increased their strength.

Other authors[11] compared four different cutout ways made in the front edge of the acrylic resin's palatine plates and arrived at the conclusion that the shape of the anterior margin of the plate.

In prosthesis plays an important role in their fatigue resistance. In this study, it was concluded that the shape of the acrylic plates of removable appliances also relates to their resistance, since, as already mentioned, the plates which covered the whole palate were more resistant.

Silva[12] evaluated the effect of treatment by microwave energy on the properties of flexural strength and microhardness of chemically activated acrylic resin dencrilay speed (Dencril, Pirassununga, and Brazil), and concluded that the treatment through microwave energy increased the flexural strength and reduced the microhardness of the evaluated acrylic resin. Authors[13-15] mentioned that occurrences such as fractures due to material fatigue are directly related to its resistance to flexion, and consequently, reinforcements, and/or treatments of the acrylic resin are proposed to improve this property.

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