الأسبوع الخامس

Lecture 5

Removable Orthodontic appliances

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Removable orthodontic appliance

Appliances that are designed to be taken out from the mouth by the patient

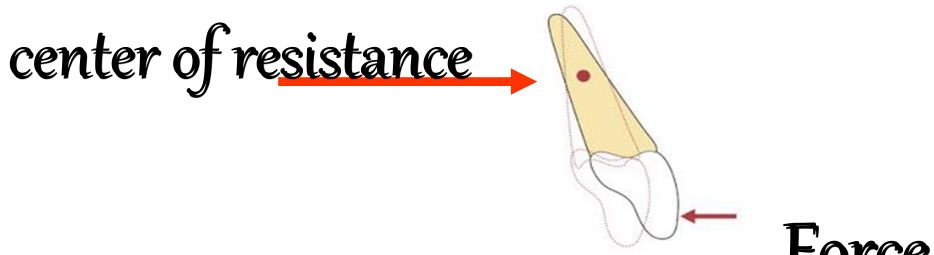
mode of action of removable appliances

Removable appliances are capable of the following types of tooth movement:

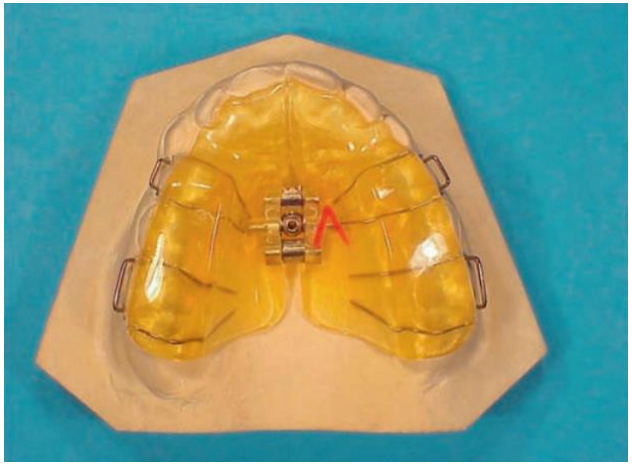
- Tipping movements – because a removable appliance applies a single point contact force to the crown of a tooth, the tooth tilts around a fulcrum (*center of resistance*)* which in a single-rooted tooth is approximately 40 per cent of the root length from the apex.
- Movements of blocks of teeth – because removable appliances are connected by a baseplate they are more efficient at moving blocks of teeth than fixed appliances.
- Influencing the eruption of opposing teeth – this can be achieved either by use of: (1) a flat anterior bite-plane, which frees the occlusion of the lower incisors allowing their eruption. This is useful in overbite reduction

(2) buccal capping, which frees the contact between the buccal segment teeth in anterior crossbite correction. This may also be of value when intrusion of the buccal segments is required.

Tipping movements



Movements of blocks of teeth



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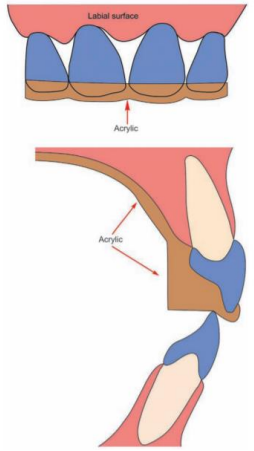
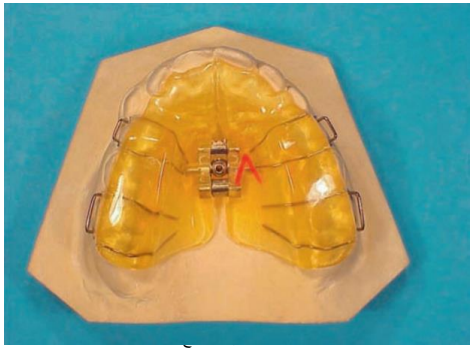


(2) buccal capping, which frees the contact between the buccal segment teeth. This may also be of value when intrusion of the buccal segments is required.

Indications for the use of removable appliances

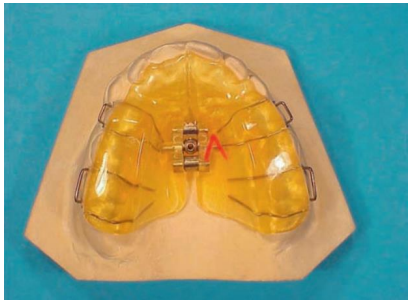
Although widely utilized in the past as the sole appliance to treat a malocclusion, with the increasing availability and acceptance of fixed appliances the limitations of the removable appliance have become more apparent.

The removable appliance is only capable of producing tilting movements of individual teeth, but can lead to a compromise result if employed where more complex tooth movements are indicated. As a result the role of the removable appliance has changed and it is now widely used as an adjunct to fixed appliance treatment.

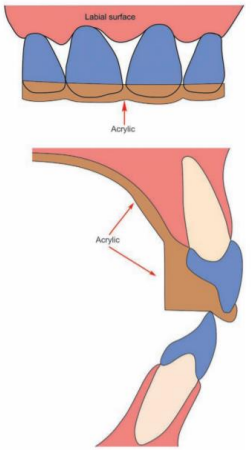


Removable appliances provide a useful means of applying extraoral traction to segments of teeth, or an entire arch, to help achieve intrusion and/or distal movement.

Removable appliances are also employed for arch expansion, which is another example of their usefulness in moving blocks of teeth.



Removable appliances are particularly helpful where a flat anterior bite-plane or buccal capping is required to influence development of the buccal segment teeth and/or to free the occlusion with the lower arch.



Removable appliances are also utilized in a passive role as space maintainers following permanent tooth extractions and also as retaining appliances following fixed appliance treatment.

Advantages & Disadvantages

Advantages	Disadvantages
Can be removed for tooth-brushing	**Appliance can be left out**
Palatal coverage increases anchorage	Only tilting movements possible
Easy to adjust	Good technician required
Less risk of iatrogenic damage (e.g. root resorption) than with fixed appliances	Affects speech
Acrylic can be thickened to form flat anterior bite-plane or buccal capping	Intermaxillary traction not practicable
Useful as passive retainer or space maintainer	Lower removable appliances are difficult to tolerate
Can be used to transmit forces to blocks of teeth	Not efficient for multiple individual tooth movements at the same time

Lower removable appliances are generally less well tolerated by patients. This is due in part to their encroachment upon tongue space, but also the lingual tilt of the lower molars makes retentive clasping difficult.

Although less likely to cause iatrogenic damage, for example, root resorption or decalcification, removable appliances can be detrimental to the patient if used inappropriately.

Skill is required to judge the situations where their use is applicable and to carry out tooth movement effectively.

removable appliances are mainly fabricated from stainless steel wire and acrylic

The most popular wire is stainless steel, because it is relatively inexpensive, easily formed and exhibits good stiffness. Because of these characteristics, stainless steel is particularly useful in the later stages of treatment.

Designing removable appliances

General principles

The design of an appliance should never be delegated to a laboratory as they are only able to utilize the information provided by the plaster casts.

Success depends upon designing an appliance that is easy for the patient to insert and wear, and is relevant to the occlusal aims of treatment

Steps in designing a removable appliance

Four components need to be considered for every removable appliance:

- Active component(s)
- Retaining the appliance
- Anchorage
- Baseplate

Generally, extractions should be deferred until after an appliance is fitted. The rationale for this is two-fold:

(1) If the extractions are carried out first, there is a real risk that the teeth posterior to the extraction site will drift forward, resulting in an appliance that does not fit well or even does not fit at all.

Steps in designing a removable appliance

(2) Occasionally a patient decides after an appliance is fitted that they do not wish to continue wearing it and therefore decide against continuing with treatment. It is obviously preferable if this change of mind occurs before any extractions have been undertaken.

Rarely, it is necessary to carry out extractions first, for example when a displaced tooth will interfere with the design of the appliance. However, even in these cases it is preferable to take impressions for the fabrication of the appliance before the extractions and to instruct the technician to remove the tooth concerned from the model. The appliance should then be fitted as soon as practicable after the tooth, or teeth are extracted.

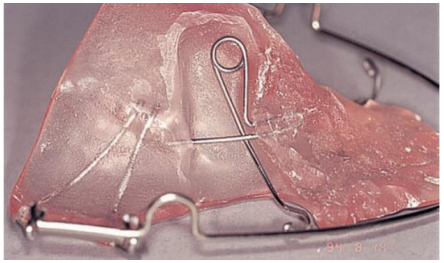
Components of removable appliances

1. Active component: Springs, labial bows, screws, and elastics.
2. Retentive components: Clasps and bows.
3. Anchorage: Clasps and contact of baseplate with nonmoving part,
4. Baseplate: Forms the framework and also provides anchorage.

active component

Springs

Springs are the most commonly used active component. Their design can readily be adapted to the needs of a particular clinical situation and they are inexpensive. However, a skilled technician is required to fabricate a spring that works efficiently with the minimum of adjustment on fitting.



Palatal finger spring. Note that the spring is boxed in with acrylic and a guard wire is present to help prevent distortion

Buccal canine retractor (distal section sleeved in tubing).

active component

Springs

The expression for the force F exerted by an orthodontic spring is according to the following formulae :

$$f \propto \frac{r^4.d}{l^3}$$

1. **f = force**
2. **r = radius**
3. **d = deflection**
4. **l = length**

where d is the deflection of the spring on activation, r is the radius of the wire and l is the length of the spring.

active component

spring

Wire Dimension and Force of the Appliance

- Doubling the diameter of the wire increases the force or stiffness by 16 times.
- Doubling its length reduces the force by eight times.
- The deflection for a given load is proportional to the third power of the length of the spring and inversely to the fourth power of its diameter.
- Incorporation of a coil increases the effective length of the spring and thereby increases the deflection

active component

spring

Thus even small changes in the diameter or length of wire used in the construction of a spring will have a profound impact upon the force delivered,

It is obviously desirable to deliver a light (physiological) force over a long activation range, but there are practical restrictions upon the length and diameter of wire used to construct a spring.

active component

spring

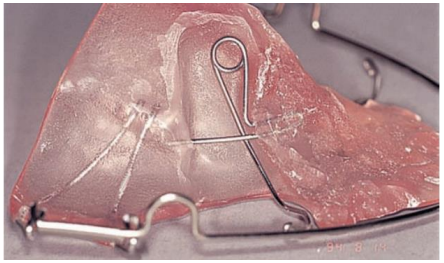
The span of a spring is usually constrained by the size of the arch or the depth of the sulcus. However, incorporating a coil into the design of a spring increases the length of wire and therefore results in the application of a smaller force for a given deflection.

A spring with a coil will work more efficiently if it is activated in the direction that the wire has been wound so that the coil unwinds as the tooth moves.

In practice the smallest diameter of wire that can be used for spring construction is 0.5 mm. However, wire of this diameter is liable to distortion or breakage and therefore some designs are protected by acrylic e.g. the palatal finger spring or strengthened by being sleeved in tubing.

active component

spring



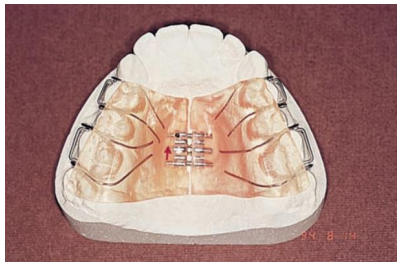
Palatal finger spring. Note that the spring is boxed in with acrylic and a guard wire is present to help prevent distortion

Buccal canine retractor (distal section sleeved in tubing).

active component

Screws

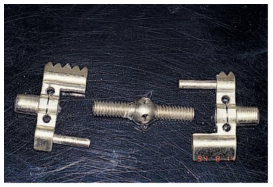
Screws are less versatile than springs, as the direction of tooth movement is determined by the position of the screw in the appliance. They are also bulky and more expensive. This is helpful when a number of teeth are to be moved together for example in an appliance to expand the upper arch or in the mixed dentition where retaining an appliance is always difficult.

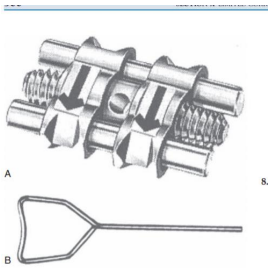


Screws

The most commonly used type of screw consists of two halves on a threaded central cylinder turned by means of a key which separates the two halves by a predetermined distance, usually about 0.25 mm for each quarter turn.

Activation of the screw: One quarter-turn opens the two sections of the appliance by 0.25 mm





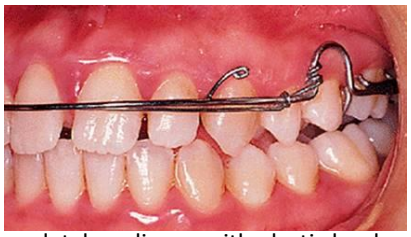
Activation of a screw is limited by the width of the periodontal ligament, as to exceed this would result in crushing the ligament cells and cessation of tooth movement

active component

Elastics

Special intra-oral elastics are manufactured for orthodontic use. These elastics are usually classified by their size, ranging from 1/8 inch to 3/4 inch, and the force that they are designed to deliver, usually 2, 3.5 or 4.5 ounces.

Selection of the appropriate size and force is based upon the root surface area of the teeth to be moved and the distance over which the elastic is to be stretched. The elastics should be changed every day. Latex-free alternatives are now widely available.



Modified removable palatal appliance with elastic hooks substituted for labial bow to retract maxillary incisors.

Retentive component

Adams clasp

Labial bow

Ball-ended clasp

Ideal Requisites For A Clasp

- **Clasps should provide adequate resistance against displacement.**
- **Clasps should be passive.**
- **They should not produce unwanted tooth movement.**
- **Active clasps can exert a palatal force on the teeth.**
- **They should be easy to fabricate.**
- **Adjustments should be easy.**
- **It should not get distorted easily due to frequent removal and insertion.**
- **Clasps should not interfere with occlusion.**
- **Clasps should be versatile, i.e. modification according to usage must be possible.**
- **Clasps should provide retention in partially erupted and deciduous teeth also.**
- **They should not irritate the soft tissues.**
- **They should function as anchorage part also, If required**