Types of Orthodontic appliances

Lecture

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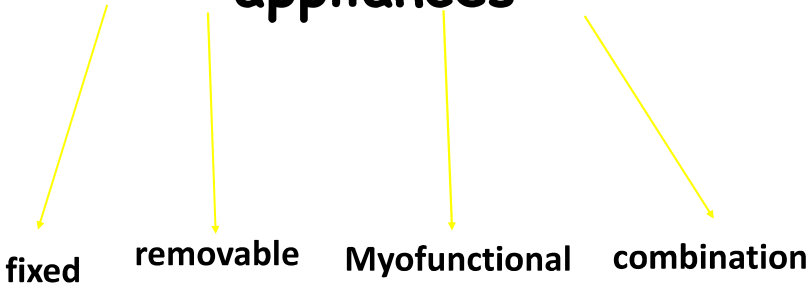
Types of Orthodontic appliances



Orthodontic appliances

Passive OAs = no force----no movement

Active OAs = force----tooth movement

Orthodontic appliances

Passive Orthodontic appliances

Passive appliances do not exert force

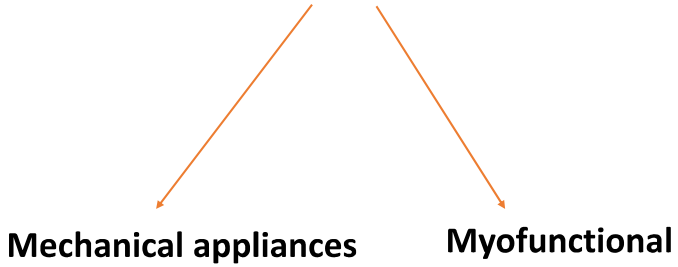
Passive appliances are used to maintain the existing occlusion (space maintainers, retainers, habit breakers and to disocclude the dentition (bite-blocks).

Orthodontic appliances

Active OAs = force----tooth movement

appliances exert force to tooth or group of teeth through mechanical devices or active components or by force of musculature

Active Orthodontic appliances



Active Orthodontic appliances

Mechanical appliances

Mechanical appliances exert force to tooth or group of teeth through mechanical devices or active components

Orthodontic appliances

Myofanctionalappliance

Myofanctional appliance alter the neuromuscular activity during function. They are also called functional appliances

Orthodontic appliances

Removable orthodontic appliances: Appliances that are designed to be taken out from the mouth by the patient

Orthodontic appliances

Intra- oral orthodontic appliances

Extra-oral orthodontic appliances

Orthodontic appliances

1. Attached removable appliances
a. Active
- Headgears
- Facemask
- Chin cups
- Lip bumpers

b. Passive
- Space maintainer
- Retainers
- Habit breaker

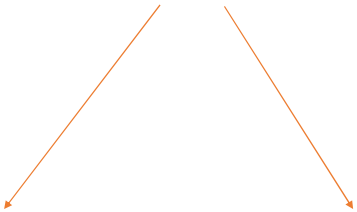
2. Loose removable appliance/functional appliance

3. Fixed appliances
a. Mechanical
b. Functional

Removable orthodontic appliance

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

Active Orthodontic appliances



Mechanical appliances **Myofunctional**

Removable orthodontic appliance (mechanical)

Removed by the patient

Removable appliances are mainly fabricated from :

1. **Stainless steel wires**
2. **Acrylic**
3. **Others : as screw & elastics**

The most popular wire is stainless steel, because it is relatively inexpensive, aeasily formed and exhibits good stiffness.

Orthodontic force:-

The force applied by removable appliances is light and intermittent. Since the best pressure to move a tooth is (25 - 30 g/ 1cm2) root surface, so the springs are designed to give that amount of pressure.

Mode of action of removable appliances

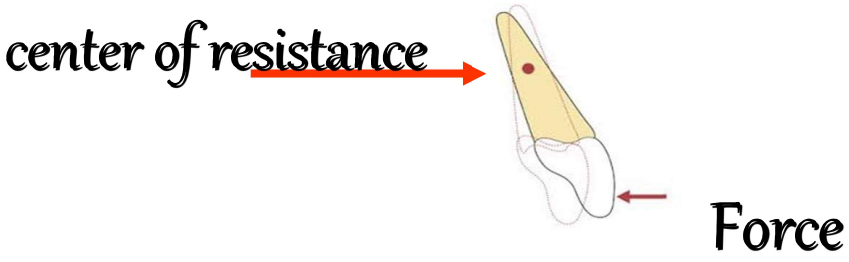
Removable appliances are capable of the following types of tooth movement:

1. Tipping movements (active components)
2. Couple force system (rotation less than 90°): by two active components in opposite direction).
3. Movements of blocks of teeth (screw)
4. Influencing the eruption of opposing teeth (modified Baseplate i.e. Baseplane).

mode of action of removable appliances

- 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.

Tipping movements



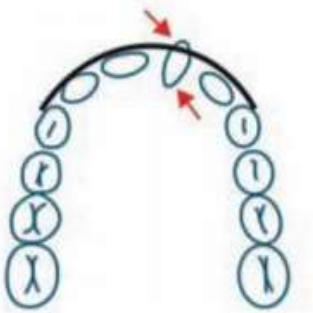
Tipping movements

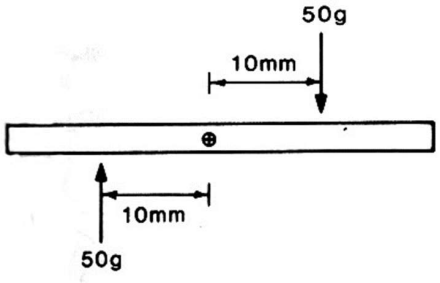
CORRECTS BY Tipping movement
Could be corrected by removable O.A

CORRECTS BY bodily movement
Need Fixed Orthodontic Appliance

Force

Couple force system





Two forces; equal magnitude; parallel and non-collinear; opposite sense

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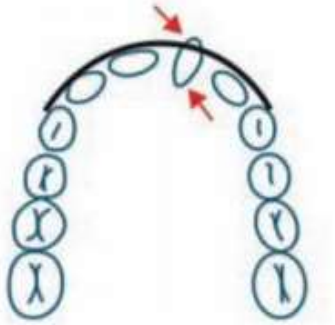
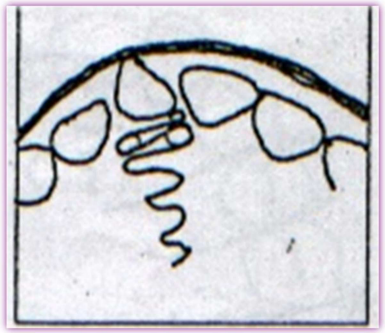
Couple force system

Rotation < 90°

Resolves by removable orthodontic appliances





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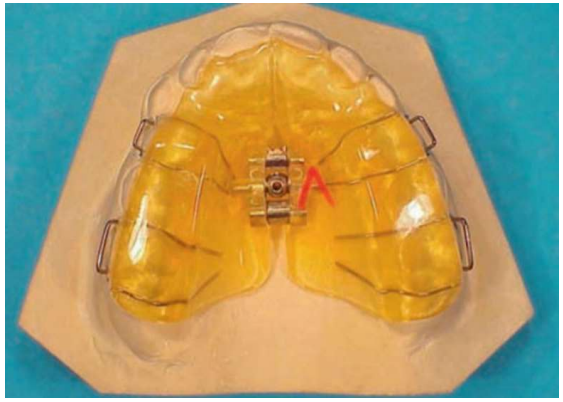
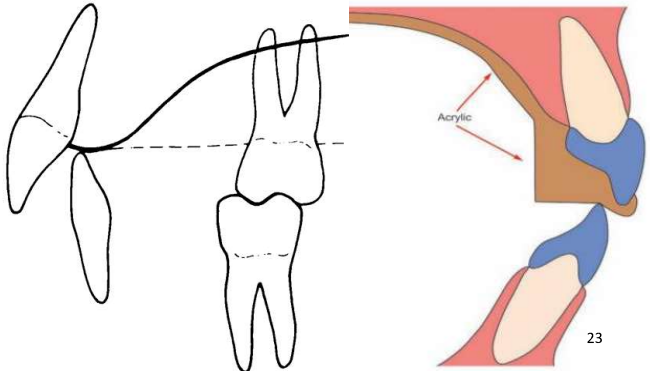
Couple force system

- 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.

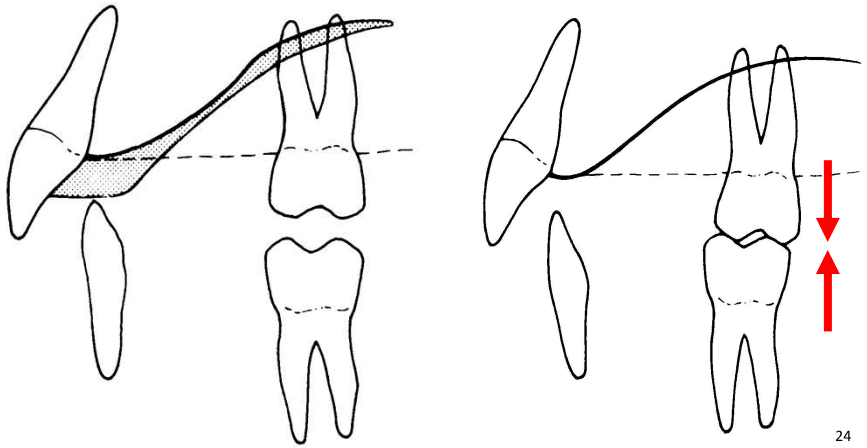


- Influencing the eruption of opposing teeth – this can be achieved either by use of: (1) a flat anterior bite-plane, which frees the occlusion of the lower incisors allowing over eruption of posterior teeth . This is useful in overbite reduction

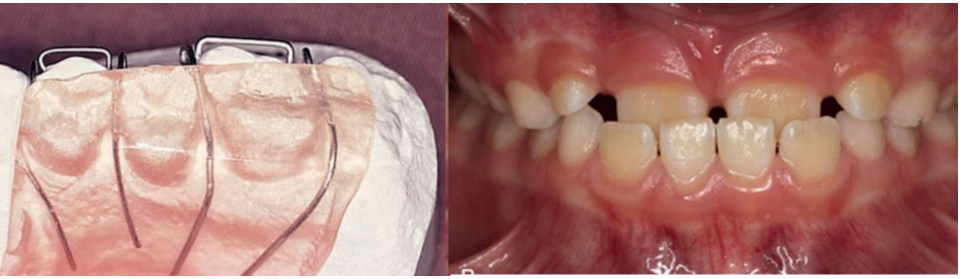


- Influencing the eruption of opposing teeth

Correction of deep bite by separating the molars allowing over-erupt and so decreasing the overbite them to



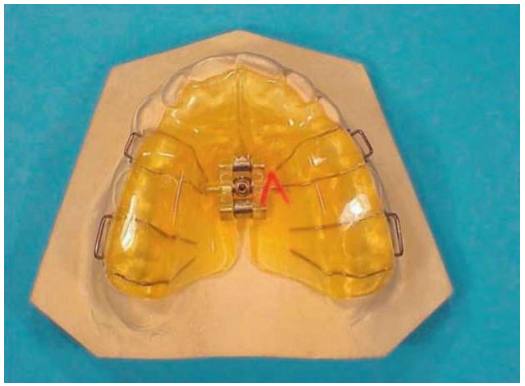
(2) buccal capping, which frees the contact between the buccal segment teeth. This indicated in correction of anterior croosbite & may also be of value when intrusion of the buccal segments is required.



Indications of removable appliances

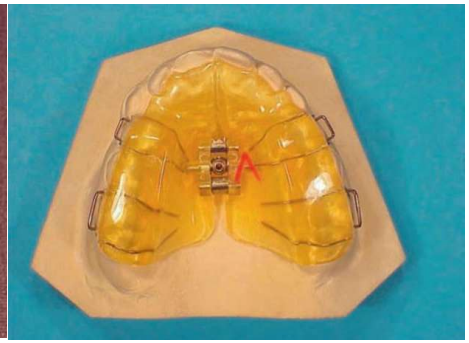
Although widely utilized in the past as the sole appliance to treat a malocclusion, with the increasing availability and acceptance of fixed appliances the limitations of the removable appliance have become more apparent.

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.

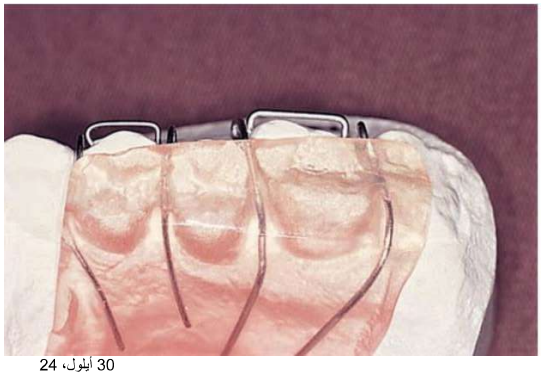


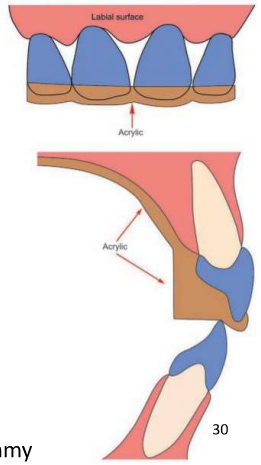
Removable appliances provide a useful means of applying extraoral traction to segments of teeth, or an entire arch, to help achieve intrusion and/or distal movement.

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.





Passive removable orthodontic appliances

- Space maintainer
- Retainers
- Habit breaker

Space maintainer

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.

Retainers

Removable retainers

Essix (invisible retainer)

Hawley retainer)

Habit breaker

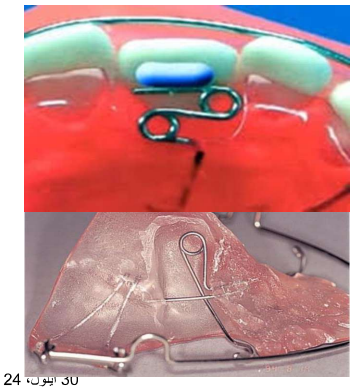
Components of removable appliances

1. Active component: Springs, labial bows, screws, and elastics.
2. Retentive components: Clasps and bows.
3. Anchorage: achieved from acrylic baseplate & retentive components.
4. Baseplate (acrylic): 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.



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.

Active component

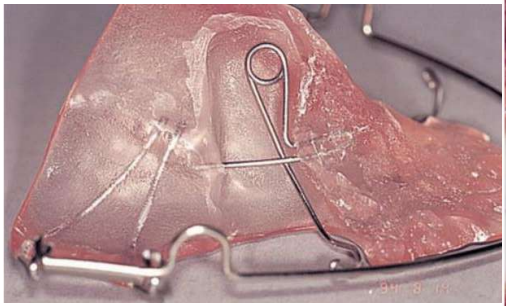
Spring

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

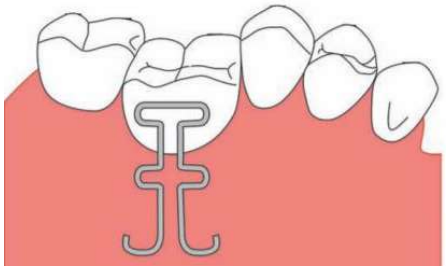


Palatal finger spring. Note that the spring is boxed in with acrylic and a guard wire is present to help prevent distortion

Buccal canine retractor (distal section sleeved in tubing).

T Spring

Alternative to Z spring



Active component

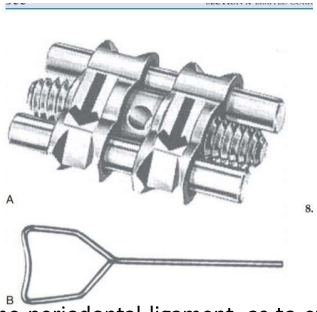
Screws

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



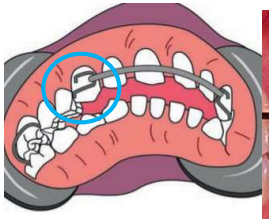
Activation of a screw is limited by the width of the periodontal ligament, as to exceed this would result in crushing the ligament cells and cessation of tooth movement

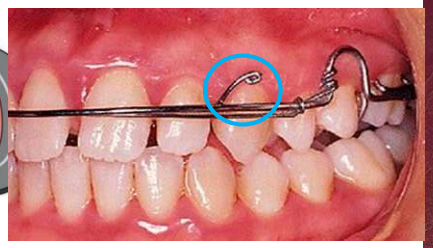
Active component

Elastics

Special intra-oral elastics are manufactured for orthodontic use. These elastics are usually classified by their size and the force that they are designed to deliver.

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.

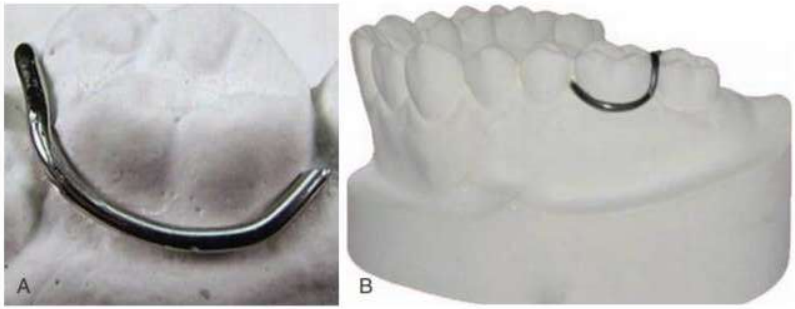
Retentive component

- 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 otherwise 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

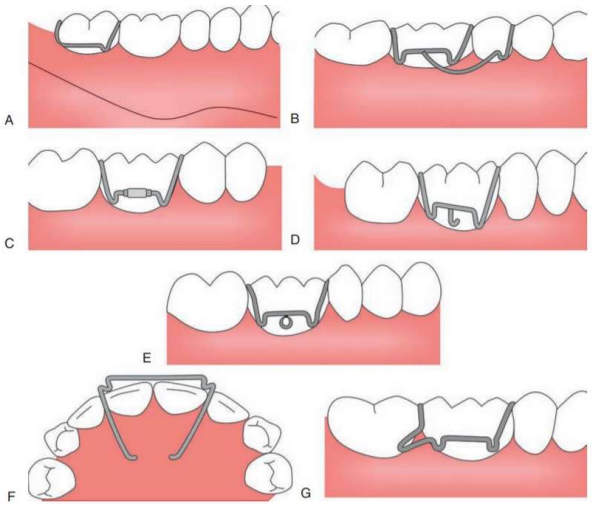
Clasps



(A) Circumferential clasp extending to the distobuccal undercut. (B) Modification of C clasp.

Clasps should be versatile, i.e. modification according to usage must be possible.

Clasps should be versatile, i.e. modification according to usage must be possible.



Modifications of Adams' clasp. Adams' clasp with single arrowhead (A); additional arrowhead (B); soldered headgear tube (C); J hooks (D); helix (E); double Adams' clasp (F) and distal extension

Acrylic baseplate

Self-cure or heat-cure acrylic:

Heat-curing of polymethylmethacrylate increases the degree of polymerization of the material and optimizes its properties, but is technically more demanding to produce.

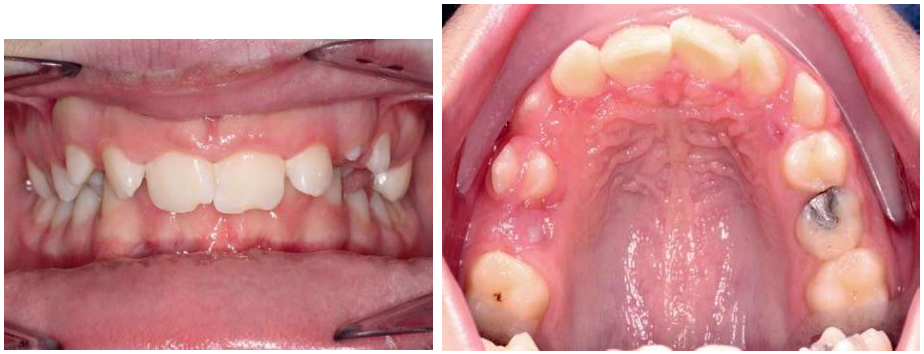
Acrylic baseplate

It is common practice to make the majority of appliances in self-cure acrylic, retaining heat-cure acrylic for those situations where additional **strength is desirable**, for example **some functional appliances**.

Modifications of acrylic base plate

1. **Flat anterior bite plane**	**Separate teeth posteriorly**
2. **Inclined bite plane**	**Separate teeth posteriorly**
3. **Posterior bite plane**	**Separate teeth anteriorly**

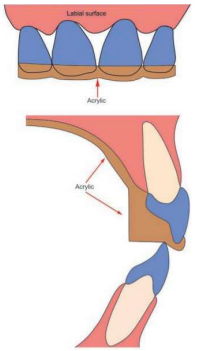
Acrylic baseplate



This patient has an obvious deep bite, with **(A)** severe overbite and **(B),** resulting damage to the palatal tissue adjacent to the maxillary incisors.

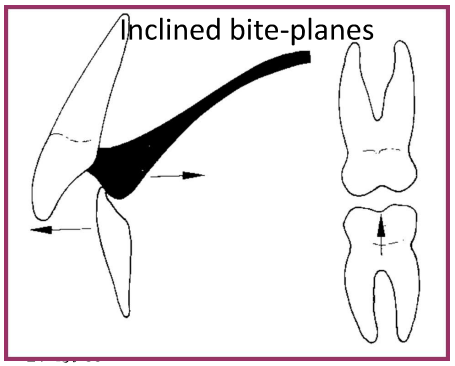
Anterior bite-plane:

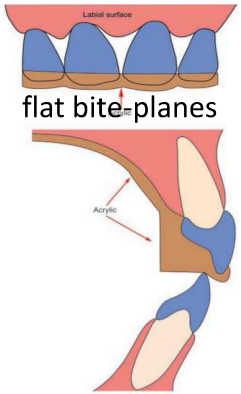
Increasing the thickness of acrylic behind the upper incisors forms a bite-plane onto which the lower incisors occlude. A bite-plane is prescribed when either the overbite needs to be reduced by eruption of the lower buccal segment teeth or elimination of possible occlusal interferences is necessary to allow tooth movement to occur.



Anterior bite-plane:

Anterior bite-planes are usually flat. Inclined bite-planes may lead to proclination or retroclination of the lower incisors, depending upon their angulation.





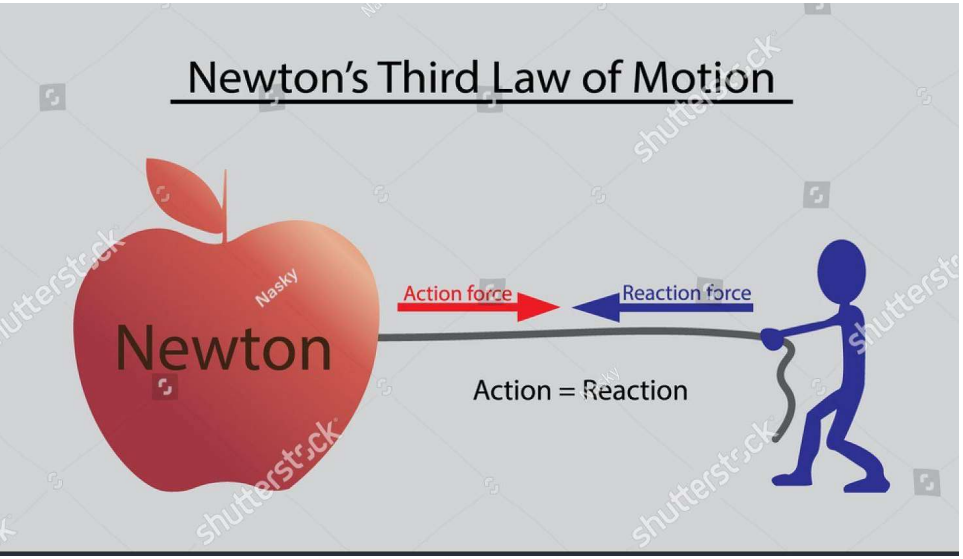
When prescribing a flat anterior bite-plane the following information needs to be given to the technician:

In a proportion of cases more than **1–2 mm** of overbite reduction is required, and therefore it will be necessary to make additions to the depth of the bite-plane during treatment.

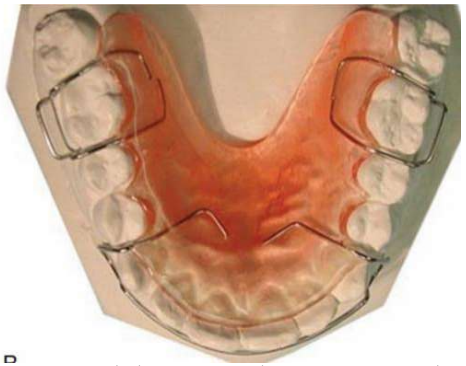
Buccal capping

Buccal capping is prescribed when occlusal interferences need to be eliminated to allow tooth movement to be accomplished. Buccal capping is produced by carrying the acrylic over the occlusal surface of the buccal segment teeth and has the effect of propping the incisors apart.

The acrylic should be as thin as practicably possible to aid patient tolerance. During treatment it is not uncommon for the capping to fracture and it is wise to warn patients of this, advising them to return if a sharp edge results. However, if as a result a tooth is left free of the acrylic and is liable to over-erupt, a new appliance will be necessary (as additions to buccal capping are rarely successful).



Anchorage



Maxillary removable appliance utilizing palatal surface for anchorage. Adam's Clasps around molars to assist in retention of the appliance and anchorage reinforcement.

Commonly used removable orthodontic appliances

To correct anterior crossbite in mixed dentition. Movement labially of upper incisors in the mixed dentition can be accomplished either using a spring or screw design depending upon the number of incisors to be moved. To move a single incisobuccally a Z-spring is commonly used. This design is also known as a double-cantilever spring when it is used for moving more than one tooth. Good anterior retention is required to resist the displacing effect of this spring

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.

(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.

Advantages & Disadvantages of Removable O.A

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.

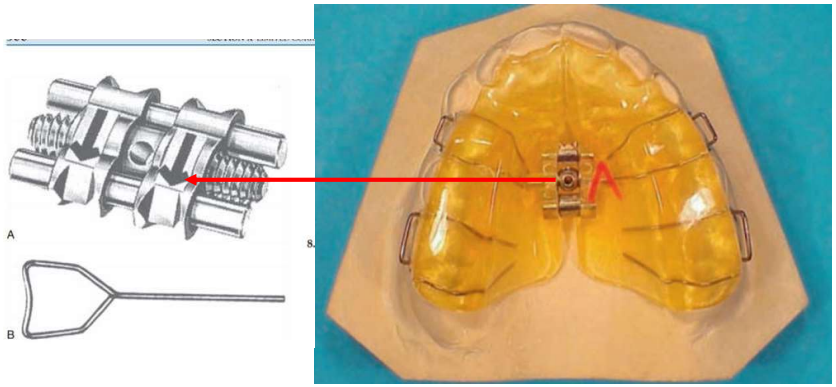
Commonly used removable appliances

1- A screw design is often used where three or all of the upper incisor need to be moved labially as then the teeth to be moved can be used for retention of the appliance. However the disadvantage is that this results in a much bulkier appliance anteriorly.

Buccal capping is usually incorporated into this appliance to free the occlusion with the lower arch.

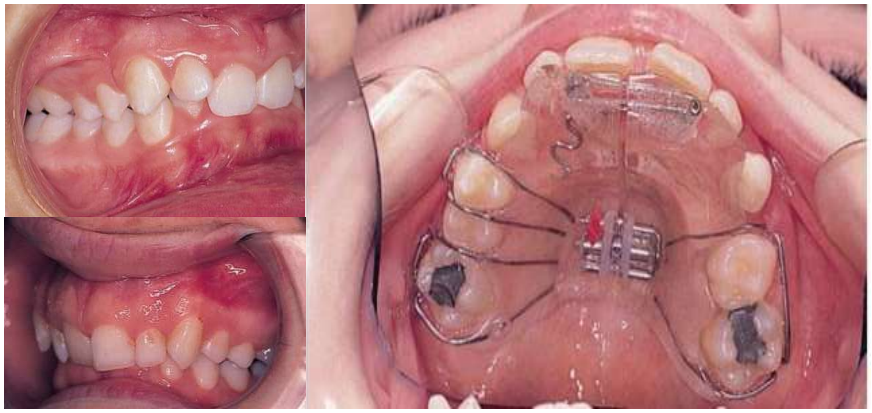
2- Screw appliance to expand upper arch

A design incorporating a screw is useful for moving blocks of teeth and has the additional advantage that the teeth being moved can also be clasped for retention. Again buccal capping is also used to free occlusion with the lower arch.



3- Expansion and Labial Segment Alignment Appliance (ELSAA)

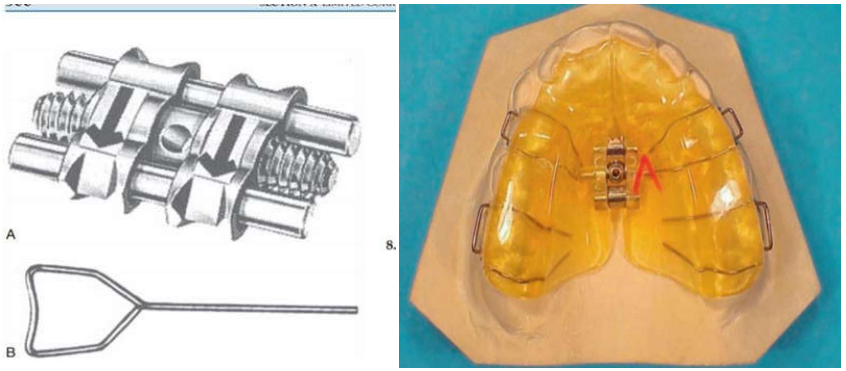
This appliance is used in Class II division 2 maloccusions prior to functional appliance therapy to correct an anteroposterior discrepancy



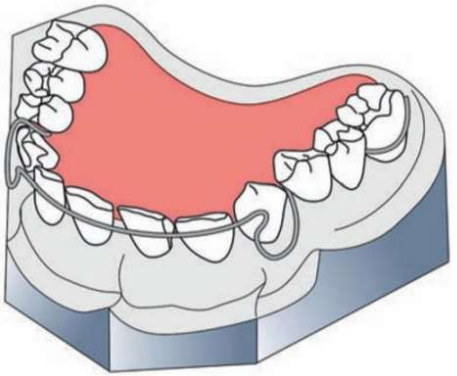
An upper removable appliance used to expand the upper arch and procline the retroclined upper incisors prior to functional appliance therapy.

Screw appliance to expand upper arch

Activation: this is by means of turning the screw a one-quarter turn. One quarter-turn opens the two sections of the appliance by 0.25 mm. For active movement the patient should turn the screw twice a week (for example on a Wednesday and a Saturday). If opened too far, the screw will come apart; therefore patients should be warned that if the screw portion becomes loose they should turn it back one turn and not advance the screw again.



4– Hawley appliance



To close anterior spaces, acrylic is cut away on the lingual side of incisors and vertical loops are closed slightly, increasing labial wire pressure on incisors.

PLEASE NOTE:

activation of Hawley appliance (active Hawley) to close anterior spaces, acrylic is cut away on the lingual side of incisors and vertical loops are closed slightly, increasing labial wire pressure on incisors.

5- 'U' loop labial bow retainer {Hawley).

The appliance generally has Adams' clasps on the upper first molars and a 'U' loop labial bow lying against the incisors.

PLEASE NOTE:

Removable appliances are:

- Only capable of tipping movements of individual teeth.
- Useful for correction of mild rotation (less than 90°) by couple force system.
- Useful for moving blocks of teeth (screw).
- Useful for freeing the occlusion with the opposing arch
- Useful as passive appliances.
- More commonly used nowadays as an adjunct to fixe appliances (rather than the sole appliance to correct a malocclusion).